ILLUSTRATED

ELECTRICAL REVIEW

A Journal of Scientific and Electrical Progress.

VOL. 24. No. 13. WEEKLY.

NEW YORK, WEDNESDAY, MARCH 28, 1894.

$3 per Annum. Single Copies, 10 Cents.

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Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

A correspondent sends to London *Lightning* two pretty little stories of the electric light in its early days, both incidents occurring 10 or 12 years ago, and one of them being noticed in the journals of the day. A lady having determined to appear at a fancy dress ball with an electric star in her hair was rather nonplussed as to where the battery could be fixed. Her husband gallantly came to the rescue and elected to go as an organ grinder, and attended her the whole evening with the battery concealed in his organ. This was the very first time electricity was used as a personal adornment, but shortly afterwards "Iolanthe" was produced, and it will be remembered the light was similarly employed in this opera. The second story is told of the Queen of Roumania, who was carried into a ballroom as a chrysalis and propped against the wall. The effect must have been singularly startling and beautiful when, to the amazement of the admiring crowd, she emerged from her shroud like covering one brilliant blaze of sparkling electric light.

The Pacific and European Telegraph Company's line has been opened between Buenos Ayres and Valparaiso. The rate beyond London or Brest to Bolivia, Chili and Peru will be $1.50 per word.

The fact is not generally known, perhaps, that more zinc is produced in Germany than in any other country in the world. According to Kuhlow's recent estimate, the annual exportation amounts to some 28,000 tons. The main production district is claimed for upper Silesia, where the metal is made from calamine, and also more and more from zinc blende, by distillation, and the smelting of zinc blende has led here, as in other places, to the establishment of very perfect arrangements for utilizing and preventing the deleterious effects of the sulphurous acid generated in roasting such ores. Further, though the smelting of zinc is a matter of much difficulty in most localities, on account of the presence of other metals in the ore, this trouble is overcome, it seems, by a careful preparation of the ores and purification of the zinc obtained; by the use, too, of regenerative gas heating furnaces and well-adapted condensers, the cost of production has been reduced and loss of metal prevented. With the smelting of the zinc a small production of cadmium is connected.

The Liverpool electric elevated railway, which has been in existence about a year, has proved completely successful in operation. It is five miles long, and its total cost, including equipment and all other charges, has been £550,000. A five minute service of trains is maintained with perfect regularity, and so far without mishap of any kind. On a recent holiday 40,000 passengers were carried in eight hours.

The Grand Avenue Cable Company, of Kansas City, Mo., is experimenting with electrical push buttons for the cars of their system. Eight push-buttons, four on each side, will be placed in a car. These will be connected to two signal bells, one for the gripman and one for the conductor, so that the passenger can give a signal to stop the car without being compelled to first attract the attention of the conductor. The bells are operated by a dry battery. The company has already equipped one car with these buttons and bells, and as far as can now be seen everything seems to work like a charm.

The Direct United States Cable Company achieved another victory over its competitors on March 17, in transmitting to the United Press its announcement of the result of the Oxford Cambridge boat race on the Thames. Ten seconds after the dispatch was filed in London it was signaled to the United Press office in this city, thus anticipating the announcement by other lines from three to 10 minutes.

The electric light and power station for the town of Chambéry, near Lyons, France, is remarkable for the height of the waterfalls used to drive the turbines. These falls are on the Isère, about 11 miles from Chambéry, and the total head is 2,010 feet. They will furnish about 2,000 horse-power. The turbines are to drive seven 120 kilowatt alternate current dynamos, giving an electromotive force of 5,000 volts. At the points of distribution the potential will be reduced to 110 volts by transformers.

Long-Distance Telephony in Spain.

An important long-distance telephone line is being constructed between Madrid and Barcelona, a distance of about 500 miles. The line will pass through Saragossa and is expected to be ready within three months.

The Aerodromic System of Transportation.

A NOVEL METHOD OF TRANSIT IS THE CHASE-KIRCHNER SYSTEM—AN ELECTRO-FLYING MACHINE IDEA OPERATING ON AN ELEVATED STRUCTURE.

Lieut. G. N. Chase, U. S. A., and H. W. Kirchner, F. A. I. A., of St. Louis, Mo., have evolved a system of transportation which is illustrated herewith and which is extremely novel in its conception. Electricity and wings form the motive power, and the motion is expected to be a sort of compromise between flying and crawling, accomplished on an elevated structure. The problem which the inventors have undertaken to solve is the construction of a machine which will be able to run upon the air at great speed, guided by a track in absolute safety and supplied with power.

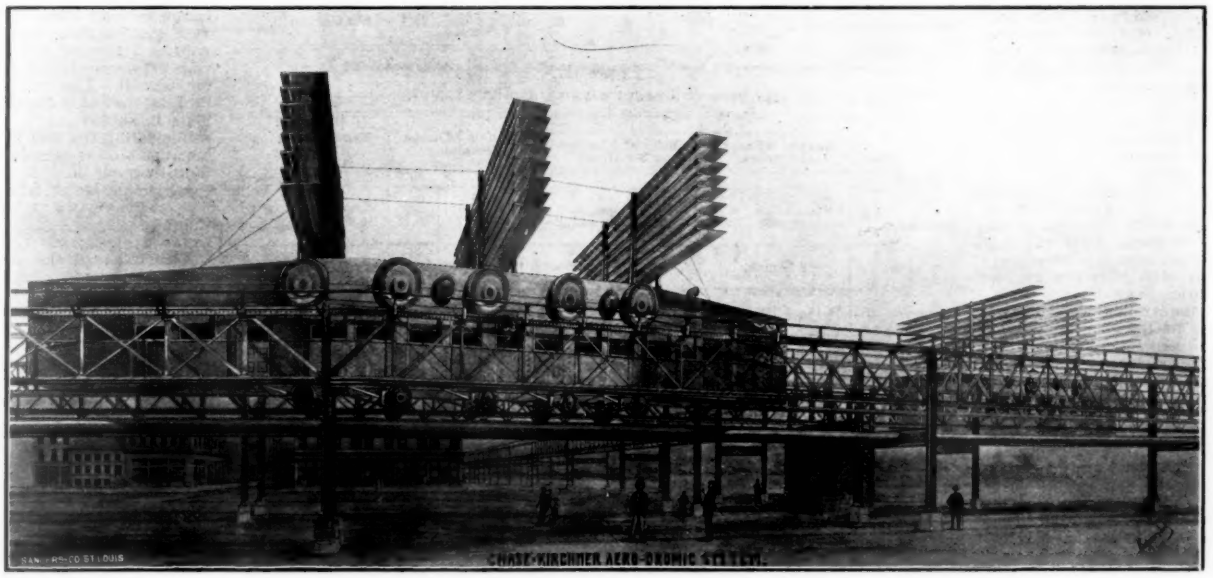

FIG. 1.—GENERAL VIEW OF THE AERODROMIC SYSTEM OF TRANSPORTATION.

The track is elevated and of steel. It consists of two parallel trusses six feet in depth and about 11 feet apart. The upper and lower chords of these trusses form the rails or guides. This trussed roadway is supported upon steel columns, a variation in the height of which helps to modify the grade where necessary. These columns are firmly fastened to stone or concrete foundations and are thoroughly braced. The spans average about 37 feet in length, but may be varied to suit the requirements of the train. They are tied from the underside to prevent spreading and are made absolutely rigid. The rails are of especial design. The lower ones are reversed and so constructed as to give a bearing for wheels on their lower

sides. The track will be practically a right line between stations, in the immediate vicinity of which curves may be introduced if necessary.

The cars will be of different lengths, from 40 to 100 feet, and of sufficient cross-section to give all of the usual interior arrangements for comfort. They can also be adapted to all classes of freight. All cars will necessarily be inclosed and of a stream-line form, since a body of such shape meets only with a frictional resistance in passing through the air. Cars for grain and coal will contain hopper-shaped bins, and will be unloaded from underneath. As the cars are usually to be suspended from the top, the method of building must be reversed. The sides and bottom will consist of light trussed framework of steel, while the top will be a strong platform, to the underside of which the motors are attached. The whole outside shell will be a continuous surface, presenting no abrupt features. The cars will be fireproof, heated and lighted by electricity. The windows will be immovable, and ventilation will be through tubes with automatic valves.

To the top of the car and at equal distances apart are attached sets or banks of aeroplanes (technically so called), arranged in form, "aspect" and position as suggested by experiments which have been made. The area of such surfaces will vary, according to the load, from 2,000 to 4,000 square feet.

These planes are hinged at their rear edge to an immovable standard perpendicular to the top of the car, and at their front edge to a movable standard by linked levers. These front standards can be elevated or depressed, thus raising or lowering the front edge of the planes. The planes in each bank, operated simultaneously by the engineer, are capable of being set at any angle from zero to 10 degrees or more. Each plane is from 20 to 30 feet in length, by four to five feet in width, and thoroughly braced. In the banks the aeroplanes will be superimposed, one directly above the other, at a distance slightly less than their width, measured from the advancing edge to the rear, this being the smaller dimension.

The axles of the driving wheels, four or more in number, pass through the top of the car and are journaled in the sides of it. These journal boxes are capable of a considerable horizontal as well as a slight vertical motion. The former movement performs the office of the bogie in the ordinary car, permitting the axles to accommodate themselves to curves. The driving wheels are four to six feet in diameter. Each axle carries two motors, with the armatures directly upon it, one motor upon either extremity, of from 25 to 50 effective horsepower each, connected in series.

The motors will be of a type yet to be chosen. They will be upon a metallic circuit of 5,000 to 10,000 volts, converted to 500 volts for the motors, and delivering power depending upon the service required. The supply and return conductors will be supported from the top of the posts wherever they occur, and at points along the spans, and will have no line drop. They will be of such form that while giving greater economy in material, they will offer the greatest resistance to flexure.

The axle of the trolley wheels passes through the sides of the car near the top, with journals the same as the driving axles, but in insulated bearings. The trolley wheels have a contact on the upper side of the conductor, and being free to fall by their own weight, and that of their axle, a perfect contact will always be insured. The trolley axle is provided with the usual brushes and distribution discs, fastened to the top of the car by a spring post device which keeps the brushes in close contact with the copper sleeve of the axle. These sleeves are removable, and, after a certain wear, they, with the wheels, can be taken off and recast.

In the engineer's room is located an air-pump which actuates a system of rods and levers underneath the car. To these are attached several sets of axles that pass across the bottom of the car. Their wheels (about two feet in diameter) do not ordinarily engage the under side of the lower rails. The object of these wheels is to keep the car upon the track, prevent oscillation and possible swaying from side winds, and to generate a friction for traction or retardation. These results are accomplished by the automatic air-pump and system of levers beneath the car, which, besides operating the air brakes attached to these lower wheels, give the journals a vertical motion, thus bringing the wheels upward against the lower rails, forming a clutch or grip between the upper and lower wheels upon the rails. The track descending in either direction from stations, starting and stopping are facilitated.

Whatever the weight upon the track, the center of gravity is several feet below the line joining the points of suspension, instead of several feet above it, as in the case of the present railroads.

Presupposing the fact that the aeroplanes can lift the greater part of the load upon a level or even upon a grade, there is no reason why just enough weight should not be carried upon the driving wheels to give the necessary adhesion to the rails for traction. Upon an ascending grade it is argued that if all but this weight can be lifted from the track, and this equilibrium be maintained, but little more work will be needed to propel the car up the grade than on a level. But more work is necessary to maintain this condition of things. It is, however, not to be compared in amount to that necessary to force the load up the hill by the ordinary rolling method, and yet maintain a high velocity.

In ascending grades, then, the engineer by manipulating the planes, preserves the lift of the machine, only this weight remaining upon the track. He calls into use for this purpose a reserve of power, and so reaches the summit with the speed slightly reduced. Descending grades or in stopping he has two methods of retardation; first by means of the air-brakes, and second, by increasing enormously the atmospheric resistance of the attached aeroplanes, by setting them at such an angle that their vertical projection offers, approximately, the same resistance that a normal plane of like extent would offer. The problem of retardation thus apparently becomes a simple one.

Patent Office Report for 1893.

Commissioner of Patents John S. Seymour submitted his annual report for the calendar year 1893 to Congress on March 22. The total number of applications for patents received during the year was 37,293; for designs, 1,060; for re-issues, 120; for caveats, 2,247; for trade-marks, 1,899, and labels, 401. There were 23,670 patents granted, including designs, 99 patents re-issued and 1,677 trade-marks registered. The number of patents which expired was 14,172. Those forfeited for non-payment of final fees numbered 4,102. The total expenditures were $1,141,038, making the excess of receipts over expenditures $101,833. The total receipts over expenditures to the credit of the Patent Office now held by the United States Treasury amounts to $4,281,743. At the beginning of the year the applications awaiting action aggregated 9,127. The number of applications now pending is 6,261. Concerning the photo-lithographic contract, the commissioner says:

"The Lithographing company was the lowest bidder; while the bid of the old company exceeded the reduced appropriation by over $4,000. Expected delays occurred at first, but the arrears were subsequently recovered and the quality of the work fully sustained.

"Administrative reasons made it desirable that the work should be taken away from the former contractor and given to another, with whatever inconvenience might result."

On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK AND CHICAGO, MARCH 21, 1894, BY PROF. WILLIAM A. ANTHONY.

Since the issue of Edison's incandescent lamp patent in 1880 it has been the generally accepted theory that the principal cause of the decay of the filament of an incandescent lamp other than oxidation was the mechanical action of the small amount of gas remaining in the chamber, wearing away the filament by the attrition due to the air currents, or, as Edison called it, "air washing." Electrical forces are also supposed to have some effect, carrying the carbon from the filament to the walls of the chamber. The perfection of the electric lamp upon this view was to be sought in the direction of a higher vacuum, and more firm and solid carbons with a smoother surface. Improvements in carbons have done much to improve the lamp. As carbons are now made—built up by deposit from a hydro-carbon vapor—every interstice is filled and the surface becomes almost as smooth as, and has almost the appearance of, polished steel. Such a carbon withstands well the "air-washing" effect of the residual gases, and the life of the lamp at a given temperature is greatly increased. But as it is greater economy, up to a certain point, to increase the temperature and save energy than to keep the temperature down and save lamps, temperatures have been increased as carbons have been improved and efficiencies have been raised, until in new lamps, at least, a candle-power is obtained from less than three watts, instead of four or more. But with these higher efficiencies comes a new cause of deterioration not so apparent in the low temperature lamps, the blackening of the bulb and consequent loss of transparency and decline in candle-power. When I see incandescent lamps hung for use, I involuntarily find myself looking for blackened lamps, and it is no uncommon thing to see those through which objects look dim. Sometimes I see lamps so black that they would do for smoked glass in viewing an eclipse of the sun. I have taken down such lamps and measured their candle-power and efficiency. Very often they run as low as 10 candles and six or seven watts per candle at their normal voltage, and I have found lamps below six candles and 10 watts per candle. The customer was still using these and had not "kicked" so far as I know, though he was sure he was not getting the light he did at the beginning. Generally he does not know what the matter is, thinks, perhaps, the company is parsimonious with the "electricity," but hasn't said much, "because he doesn't want to be all the time making a row." Of course, the illuminating company cannot be expected to go around and hunt up such lamps and change them; so, as long as the customer does not complain, but pays for his six or 10 candles at the price of 16, the old blackened lamps remain on the circuit until they burn out. Since such lamps increase in resistance they take less and less current, and the older and more feeble they become, the more tenacious they are of life. It is no uncommon thing to hear of such lamps that have lived through six, eight, or 10 thousand hours of active service, when, probably, not one of them was able to do its full duty, and should have been placed on the retired list at three hundred hours.

Now the question arises, is there no way to preserve the illuminating power of the lamp throughout the life of the filament? Surely a long-lived filament is of little value if it fails to give a reasonable light after two or three hundred hours.

Loss of candle-power might be avoided by lowering the temperature and with it the initial efficiency of the lamp, but this is an improvement in the wrong direction, although I am sure the customers, whether they pay for their electric energy by the meter or by the year per lamp, would be the gainers if they were furnished with lamps of lower initial efficiency, unless their lamps are changed oftener than is usually done. The present high efficiency lamp would do very well if there were any way to insure its retirement from the service when its legitimate usefulness was passed. The ideal lamp would be one that, while giving a high efficiency and a reasonable life, should die by the rupture of its filament while still doing its best work.

About a year ago Mr. John Waring began experimenting upon the effects of heavy gases in the lamp chamber, using principally the vapor of bromine as obtained from the liquid bromine of commerce. It is not necessary to describe in detail the various experiments. The final result reached was that, when bromine vapor was present in the chamber in proper quantity, the lamp, as compared with a vacuum lamp, could be run at a high efficiency without blackening or increase of resistance, therefore without loss of candle-power and with an increase in its useful life. These facts were abundantly demonstrated by numerous experiments. Below are the results of some experiments that I myself recently performed. I had made a number of 50 volt 16 candle lamps. Half of these were exhausted in the usual way as vacuum lamps. The others were made into bromine lamps after the method employed in the Waring factory. The lamps were all "volted," then four of each were run for three and a half hours at 65 volts, and for one and a half hours at 70 volts pressures—15 and 20 volts in excess of the normal. Two of the bromine lamps broke at the end of the run. The results are given in Table I.

Comparing the two kinds of lamps, it is seen that all the vacuum lamps had fallen more than one-third in candle-power, while the bromine lamps fell only five per cent. The current in the vacuum lamps had also diminished, showing an increase in resistance of the filaments of over five per cent.

Two others of the same lot of 50 volt lamps, one vacuum and one bromine, were run for five minutes at 90 volts, at which pressure the light was of a dazzling whiteness.

The results are given in Table II.

In this experiment, also, the vacuum lamp shows a very great loss in candle-power as compared to the bromine.

It may be said that these experiments were performed under abnormal conditions. They were to save time. But if the bromine will, when the filament is carried to such an abnormal incandescence, preserve to such a marked degree the illuminating power of the lamp, so much the more should it do so when the incandescence is normal.

But to remove any doubt as to the effect under normal conditions, I have obtained from Mr. Waring the results of a life test in progress at the Waring factory, and with his permission I embody them in this paper. The results as furnished me give the individual readings for eight vacuum and eight bromine lamps all identical in material and construction up to the point of exhausting the bulbs, when eight of the lamps were taken at random to be exhausted as vacuum lamps, and the remaining eight filled with bromine vapor in accordance with the regular process pursued in the manufacture of the "Novak" lamp.

As these lamps all had similar filaments, the bromine lamps would, if run at the same candle-power, have been less efficient at the start than the vacuum lamps. The bromine lamps were, therefore, "volted" for 28 candle-power and the vacuum lamps for 25 candle-power, and each lamp marked with its appropriate voltage. The bromine lamps varied from 52.4 to 55 8 volts, and the vacuum lamps from 50.5 to 52 volts. During the run the pressure was maintained for the bromine lamps at 54.15; for the vacuum lamps at 51.3. At approximately 200, 400 and 600 hours from the beginning the candle-power of each lamp was measured at its marked voltage. From the

TABLE I.

	Lamps, New			After 5 Hours at 65 and 70 Volts.			
	Volts.	c. p.	Current.	c. p.	Current.		
1	49	16	26	9.4	24	Vacuum Lamps.	Bulbs all Blackened.
2	49.6	16	26	10.3	24.6		
3	49	16	26	10.6	34.8		
4	49.2	16	26	9.8	24.8		
5	49.8	16	27	Broken.	....	Bromine Lamps.	Bulbs not Blackened.
6	48.8	16	26.5	15.5	26.2		
7	49	16	27	15.1	27.2		
8	50	16	26.5	Broken.	....		

TABLE II.

	Lamps, New.			After Five Minutes at 90 Volts.		
	Volts.	c. p.	Current.	c. p.	Current.	
Vacuum	48.2	16	26	6.9	25	Greatly blackened.
Bromine	51	16	27	12.9	26.1	Not blackened.

TABLE III.

LIFE TEST OF 8 VACUUM AND 8 BROMINE LAMPS.

	Mean of 8 Lamps at 0 Hours.			Mean of 8 Lamps at 210 Hours.			Mean of 7 Lamps Remaining at 400 Hours.			Mean of 6 Lamps* Remaining at 625 Hours.		
	Volts.	Amp.	c. p.	Volts.	Amp.	c. p.	Volts.	Amp.	c. p.	Volts.	Amp.	c. p.
Vacuum	51.35	1.6888	25	51.35	1.739	22.31	51.26	1.704	20.17	51.38	1.698	18.18
	8 Lamps.			7 Lamps Remaining.			6 Lamps Remaining.			3 Lamps Remaining.		
Bromine	54.16	1 768	28	54.36	1.816	28.26	54.92	1.792	29.24	55.37	1.857	29

* One of the 6 vacuum lamps has a very bright spot on the filament, and can only last a few hours longer.

individual readings furnished me, I have computed the mean values, which are given in Table III.

The efficiencies in watts per candle are as follows:

TABLE IV.

	0 Hours	210 Hours	400 Hours	625 Hours
Vacuum...	3.469	3.99	4.33	4.8
Bromine ..	3.421	3.49	3.41	3.54

What is the teaching of these results? Of the bromine lamps one had failed in less than 200 hours, two more in less than 400 hours, and two more, or five in all, before the end of the test at 625 hours, but the candle-powers of the lamps still doing service were even higher than at the beginning. At 400 hours there had been no loss of efficiency. At 600 hours the efficiency had only fallen about three per cent., and even this was partly due to the fact that these three remaining lamps were, at the start, below the average efficiency. The vacuum lamps, on the contrary, had failed in candle-power nearly 20 per cent. at 400 hours, and 27 per cent. at 625 hours. In efficiency they had dropped from 3.47 at the start, to 4.33 at 400, and 4.8 at 625 hours.

Although only one lamp had failed, these vacuum lamps were all practically dead at 400 hours, and in comparing their useful life with that of the bromine lamps, they should be so considered. But in whatever way the comparison is made, the bromine lamps in this test will appear as the better lamps, and yet up to the point of exhausting the chambers the bromine and vacuum lamps were precisely alike.

These results do not accord with the generally accepted belief as to the effect of a gas in the lamp chamber. Again and again I have been asked in reference to the claims for the Novak lamp:—"Is it true that they maintain their candle-power?" and, second, with considerable skepticism thrown into it:—"Well, how do you account for it?" This means, that I must submit overwhelming proof of the alleged facts, or I must account for them. I do not object to this. It would be my own position in a similar case.

I remember once, some years ago, an inventor of a new dynamo asked me to come and see it and give him an opinion of it. When I reached his shop he, unfortunately, could not show it in operation, but he assured me that his dynamo was a most wonderful machine, several times as efficient as any other known. He told me that, running it by means of a little engine that could not by any possibility give more than two horse power, and which also ran his shop, he was able to run 32 Edison 16 candle-power lamps of the old eight to the horse-power type, to full incandescence. It seemed to me it must be a wonderful dynamo to develop four horse-power from two. I asked him how he accounted for it. He could not explain it very clearly, at least I could not get the force of his explanation, and, though I saw the engine, and the dynamo, and the lamps, I expect I came away somewhat skeptical as to the performance of that machine.

Now I hope to be able to convince you before you go away to-night that the facts claimed for these bromine lamps are fully in accord with other known facts, even if they do not seem to accord with previous theories as to the action of gases in the lamp chamber.

(To be continued.)

American Institute of Electrical Engineers.

A DUAL MEETING BY TELEPHONE.

The eighty-fourth meeting of the Institute was held at 12 West Thirty-first street, New York city, March 21. A paper "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp," was presented by Prof. W. A. Anthony, of Vineland, N. J., past president of the Institute. The discussion was opened by Prof. Wm. Llspenard Robb, of Trinity College, Hartford, Conn. A meeting of the Chicago members was also held simultaneously, at which the same paper was read and discussed at the Armour Institute. The author was represented at Chicago by Prof. Dugald C. Jackson, of Madison, Wis. Through the courtesy of the Metropolitan Telephone and Telegraph Company, the American Telephone and Telegraph Company and the Chicago Telephone Company, telephonic communication was established between the two meetings, with Mr. A. S. Hibbard at the Chicago terminal and Mr. J. J. Carty in charge of the arrangements in New York city. Both gentlemen are members of the Council of the Institute. The possibility of bringing distant audiences in touch with the author of a paper was satisfactorily established, and before adjournment President Houston, at New York, spoke over the wire to attentive listeners in both cities, extending congratulations upon the success of the dual meeting, and informing the Chicago members that the report of the Committee on Units and Standards had been approved recommending the provisional adoption of the term "gilbert" for the C.G.S. unit of magneto-motive force, the "weber" for the C. G. S. magnetic unit of flux, the "oersted" for the C. G. S. unit of reluctance and the "gauss" for the unit of flux density. About 80 members and guests were present at the New York meeting, and 40 in Chicago.

ELECTRIC LIGHT FLASHES.

Marblehead, Mass., is to establish a municipal lighting plant.

Fire has destroyed the plant of the Charlottesville, Va., and University Electric Light Company. Loss, $18,000.

The New York State Senate has passed a bill extending the term of office of the Board of Electrical Control of New York city for three years.

The Suburban Electric Light, Heat and Power Company has completed its electric light plant at Kirkwood, Mo., and it is now in full operation.

The General Electric Company has filed a bill against the State of New York for $34,984.53 for damages resulting to its works at Schenectady from the flood of last March. The company claims that negligence in construction and management of the Erie Canal caused the flood.

It is now said that there is every prospect of success in getting a bill through the New York State Legislature for the formation of an Examining Board of Wiremen and Electrical Workers. Ex-Delegate C. W. Hoadley is in Albany looking after the interests of the bill, and is being assisted by all the big fire insurance companies in the State.

The Oshkosh, Wis., electric light plant is about to be sold under the hammer, and Oshkosh people will lose $50,000 in stock and bonds thereby. An attorney of the Massachusetts Loan and Trust Company, which holds a trust deed to protect $100,000 worth of bonds held by Eastern parties, has petitioned the court to order a sale. The company is now in the hands of a receiver. If the plant is sold it will not bring $100,000, and the Oshkosh people interested see no way to save themselves.

The Philadelphia council's electrical committee on March 22 agreed to report favorably the American Subway Company's ordinance, after a number of amendments had been made. The amendments included these provisions: That the subway shall not be more than six feet square; that the subways shall be made of hydraulic cement concrete, the ducts to be made of hydraulic pipes; that work shall be begun within one year of the passage of the ordinance; that the city shall have three ducts free, and that a bond for $100,000 shall be filed.

A Lightning Calculator.

The beautiful new theater of Koster & Bial's—and which, by the way, is probably the most effectively and most artistically lighted by electricity of any theater in New York—is just now a point of interest to the mathematician.

M. Inaudi, of Paris, astounds everyone by his marvelous feats with figures. With his back to a large stage blackboard he reads off accurately long lists of figures given by the audience and written down by an assistant, the figures apparently becoming photographed on his brain and remembered without effort. When later he is called upon to repeat them each figure in four different sums was correctly remembered and the problems solved, although M. Inaudi permitted a quarter of an hour to elapse after the writing of the figures on the blackboard before he read them off, devoting himself meanwhile to telling the day of the week on which anyone in the audience was born if they stated the year and day of the month. M. Inaudi explains this interesting feat by saying that one part of his brain goes ahead solving the several problems on the blackboard—the figures of which he has only heard announced once and had never seen—and another part of his queer gray matter attends strictly to the business of telling the members of the audience their birthdays!

TELEPHONE NEWS AND COMMENT.

Minneapolis is trying to reduce telephone rentals $2 per month.

The New England Telephone and Telegraph Company recently took a three days' count of telephone messages over its lines.

The Western Telephone Construction Company, of Chicago, is said to be going quietly ahead and perfecting its plans in a business like way.

The Harrison Interstate Telephone Company seems to be meeting with success in securing subscribers throughout the West. What it will do with them remains to be seen.

"Telephone Lines and Their Properties," second edition, revised and enlarged, is now out and is in much demand in telephone circles. This is a valuable work, well worth the price, $1.50.

It is reported that the Bell Telephone Company, of Canada, earned about 30 per cent. for its shareholders the past year, notwithstanding the fact that in Canada there are no patents and the field, consequently, is clear for competition.

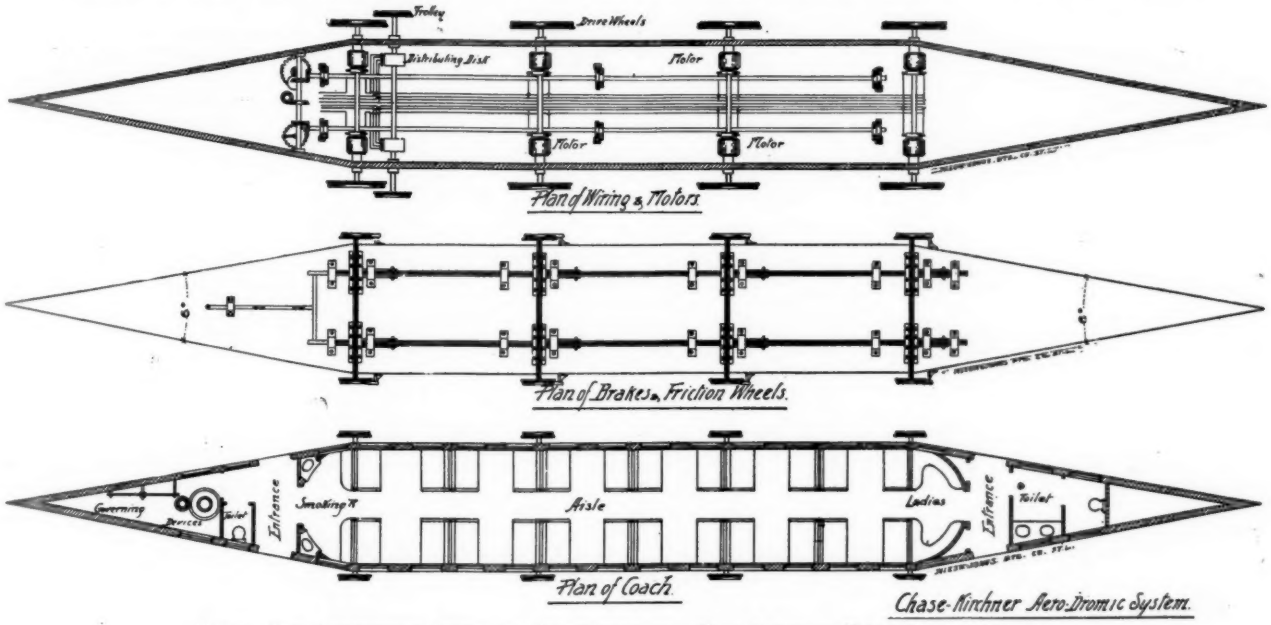

FIG. 2.—THE AERODROMIC SYSTEM OF TRANSPORTATION.—PLAN VIEWS OF MOTOR CAR AND COACH.

The Drawbaugh people are to have a New York organization with $10,000,000 capital. This amount of money, paid in, would give the company a financial strength that would make it a formidable competitor for the telephone business in this State.

M. J. Carney is to sue for his patent rights in the multiple telephone switchboard. This may or may not surprise Inventor Scribner, of the Western Electric Company. Damages it is reported will be claimed in the amount of $5,000,000—a snug little sum these hard times.

A newly-organized telephone company, called the Sunderland, would have been levied on by the sheriff in New York last week, but that official could find nothing to levy upon. This company was, it seems, organized to swindle applicants for positions out of advance payments exacted as security for their honesty.

Our correspondent at Portland, Ore., writes that there is much interest in telephone matters in that part of the United States, and efforts are being made to organize a number of exchanges in the smaller cities. In one place an exchange has been promised at the rate of $2 per month. The long-distance telephone is to be extended from Washington to Monte Christo.

Dynamos and Motors—Direct.

A LECTURE AT COOPER UNION, NEW YORK, JANUARY 29, 1894, BEING AN EXTRACT FROM THE SECOND EDITION OF "PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS," BY F. B. CROCKER AND S. S. WHEELER, DELIVERED BY DR. S. S. WHEELER.

(Concluded from page 137.)

The electrical resistance of the conductors and of the insulation of the machine are almost always tested when the merits of the machine are to be passed upon. The insulation resistance may be tested by a delicate galvanometer or by an ordinary voltmeter, such as we all use in our daily work. Take a Weston voltmeter, for example, such as this. The resistance of the insulation of any machine or of any line, or any wiring in a house, no matter how extensive, can be measured by this instrument without any additional apparatus. The instrument has about 15,000 ohms, and consequently, as a little figuring will show you, when the dynamo is giving 115 volts, if you connect this to ground and to one conductor of the machine and it points to, say, 1.7 volts, it means that the insulation is about a megohm. That follows from the fact that the instrument has about 15,000 ohms resistance, and if the resistance of the insulation cuts the reading which would otherwise be 115 volts down to one volt, it means that the insulation is about 100 times higher resistance than the resistance of the instrument.

The insulation of the conductors of a machine, that is, of the wires it is wound with, or the metallic resistance, can best be measured by passing a large current through the machine, say 100 amperes and measuring with a voltmeter the difference of potential between the brushes. That will show the amount of resistance of the armature. It cannot be measured by the ordinary galvanometers. It is most conveniently measured by the drop method just described.

The voltage of a machine is, of course, tested by applying the voltmeter directly to its terminals.

The amperes are measured by connecting the ammeter in series with the armature so that all of the current of the machine has to pass through it. If you have no ammeter you can measure it by measuring the difference in potential, that is the volts between two points on a part of the circuit. Suppose this is a dynamo, and there are a couple of large wires leading out from it. You measure a yard of the wire and calculate its resistance by measuring the diameter by a wire gauge and looking at the wiring tables. Then measuring the difference of potential between the two points on the wire a yard apart, you can tell the number of amperes flowing through the wires at any time. If you cannot measure the size of the wire but can get the use of an ammeter for short time, you can measure the current at different loads and note the volts difference on the wire corresponding to these readings and keep the record. Then, at any future time, by measuring what the volts are between these two points you can refer back to the record and find the corresponding amperes without any ammeter.

It is necessary to measure the volts and amperes of any machine to make a test of its efficiency. The speed, of course, is measured with an ordinary speed counter or with a tachometer, which is similar to a centrifugal governor having an indicator which points at once to the speed of the machine without your having to use a clock or watch to count a half minute.

The torque or turning power of the armature is measured by what is called a prony brake. It is a lever that can be clamped on the pulley, and is usually, for convenience, one foot long from the center of the shaft. This is put on the pulley and the nuts are tightened up so that it opposes a resistance to the rotation, and then the rotation pulls a certain amount on the end of the lever. That amount is weighed by a scale or by putting weights on the end of the lever. If the pulley makes one revolution when it is clamped down, the distance that the end of the lever would travel, if it were allowed to revolve, would be six and one-quarter feet. Consequently, if it pulls one pound, and the armature makes a thousand revolutions a minute, it would pull one pound through 6,250 feet; and as 33,000 pounds through a foot in a minute is one horse-power, that gives at once the power of the machine.

Unfortunately, this scale is not large enough, so you cannot all see it. But I tightened the screws until it pulled five pounds, which is enough to develop one horse-power at a thousand revolutions of the motor.

I am giving you the headings of all of the possible tests, one after another, though some are not at all interesting, in order to cover all parts of the subject.

The foregoing, if the principal operation that every motor goes through when it is being tested for power and efficiency.

The speed is measured by a tachometer belted to an extra groove in this pulley, and the amount that is pulled at the end of the one foot lever, measured when the screws are tightened, is given on the spring balance scale, and the pull multiplied by the speed gives the mechanical power delivered. The mechanical power delivered divided by the electrical power put into the machine gives the efficiency. In this machine on the floor the efficiency is about 88 per cent., I believe.

The distribution of magnetism in the different parts of the machine is often considered important and is found by winding, say, 10 turns of wire around the magnet at the top and then winding 10 turns at the bottom, and then putting a coil of 10 turns in the armature space or winding 10 turns on the outside of the armature. Then if we magnetize and demagnetize the field these different coils connected with the instrument will cause the needle to move different amounts, according to the amount of magnetism that each coil encloses. By that means the distribution of the magnetism or the amount of leakage is determined for every part; machines of this kind will send some magnetism out from the back of the magnets through the air. That part is called the "stray magnetism," and it is generally considered desirable to have that as low as possible. For this reason machines that have been called iron-clad have been built. But in machines in which the iron of the armature does not come as close to the magnets as it does in this, the amount of magnetism coming outside is very much greater than in this, because here the passage of the lines of force into the armature is encouraged by the fact that the iron comes close to the magnet. So that smooth armatures have the largest amount of scattered magnetism; armatures with teeth have less, and machines that have iron-clad frames have still less.

The separation of losses in a motor or dynamo is also often investigated, and the losses are usually divided about as follows: In a machine of 90 per cent. efficiency, 90 per cent. of the power put into it is returned in useful work. About one to three per cent. is lost in the friction of the bearings. About one and one-half per cent. is lost in hysteresis or the effort required to reverse the magnetism of the core that the armature wires are wound on—the iron in the center of this coil. About one and one-half per cent. is lost in "eddy" currents, because the same induction effect that causes the current to circulate in the wire causes it to circulate as much as it can in the iron inside the wire. This is reduced to a small amount by building the iron up in sheets that are laid in a direction opposite to the direction that the wire follows, so that the current cannot pass through the iron in the direction in which it tends. If the sheets were laid the same way as the wire, the current would flow through the sheet, because the induction lies in that direction; but they are usually laid crosswise. Nevertheless, the sheets of iron have to have some thickness, and usually about one-fiftieth of an inch is enough to permit a very small current to eddy around in the mass of iron, and that causes a loss of about one and one-half per cent. The friction of the brushes is about one-half per cent. The friction of the air against the armature is about one-half per cent. That makes up the 10 per cent. of loss; and in studying out for improvement in a motor the losses are always located. I have seen a great many charts showing just how the losses are divided at different loads. The loss of energy in the coils of the field magnets is from one to three per cent. The loss in the armature resistance is not constant. All the other losses are practically constant at all loads. But the loss in the armature increases as the current increases. When it is running free there is no energy used in the armature wire. When it is heavily loaded the loss averages about two per cent., and that makes the losses of the machine running at full load slightly greater than when running free.

I have just touched on the different features in respect to which a machine may be tested for quality. If a machine is in trouble it may be due to one of about nine causes. In each of these there are a good many subcauses.

The first cause is sparking. That is the most important.

The second is heating, which may be of the commutator, of the armature, of the fields or of the bearings.

The next is noise.

The next is that a machine may run too slow or too fast, or it may stop entirely. Or, if it is a dynamo, it may fail to generate.

To take up the first of these—sparking may be caused by a short-circuited coil, by the brushes being in wrong position, by making bad contact, or having high resistance, by one coil being reversed, by uneven commutators, by bad mica, etc.

In the next place, as to heating. That requires rather careful examination. If a machine has been running some time you may put your hand on its armature and think that it is heating, but it may be the bearing that is giving the heat. The heat is able to spread to all parts of the machine in a very short time, so that, when trying to locate the cause of heat, you should start with a cool machine and run it a short time heavily loaded, so as to develop the heat rapidly, without giving it time to spread, and then feel it and find where the heat is greatest.

Heat in the commutator may be caused by almost any of the causes of sparking, or it may be caused by something that would cause sparking if it were worse.

The heating of the armature may be caused by improper insulation of the iron plates, as just described. It may be caused by a short-circuited coil, etc.

The heating of the field magnets may be caused by the coils having too low resistance, so that they draw too much current; or by the circuit having too high a pressure, so as to force too large a current into the coil; or the fields may be wound with too fine a wire to carry the constant current. It may also be caused in the iron in the magnet itself by the passage in front of the iron of the teeth of the armature, provided the teeth do not come close enough together. If they are far apart, or the slots into which the wire is wound are not narrow, the surface of the pole piece has a succession of spots passing over it where it is delivering lines of force into the armature opposite the teeth, and others where it is not doing any work. Consequently, a current will be generated in the surface of the pole piece by the very fact that there are portions full of lines of force and portions without any, which are in rapid motion.

It is hardly necessary to go into the numerous causes of heating of bearings. If the coil is bad, or if there is grit in it, or if the bearing is too tight, or if the belt strains the shaft, it will make one or both bearings too hot; or if the end motion of the armature is not right; if it is so that the shoulder jams up against one bearing, that will make that bearing hot.

A motor or dynamo may run too slow, and in the case of a motor this may be caused by too low pressure of the current or overload, or by a short-circuited coil, which would have the effect of putting a heavy load on the machine, although it would be *in* the machine instead of outside. It may be caused by weak field magnetism. But if the field is very weak the machine will stop and very likely run in the opposite direction. This puzzles a great many people, because they cannot understand why a machine with no field circuit will run at all. The reason is that the current flowing in the armature gives the armature a certain polarity, and that reacts on the field and gives it a certain polarity, and it happens that that polarity is the opposite of the polarity given by the coils and required to run the machine right. If you have a machine running backwards and without much power, you can make up your mind that the field circuit is open.

A dynamo may fail to generate through the brushes not being in the right position. There are a great many machines in which the wires from the coils are carried part way around the armature before they are connected with the commutator. So that a person who understands perfectly the principles of machines will put the brushes on and will not be able to get any current and will be very much puzzled. For instance, an Edison dynamo, instead of requiring the brushes as they are placed here opposite the spaces between the pole pieces, requires them opposite the pole pieces. But it is electrically exactly the same as with the brushes placed as in this machine. I speak feelingly of this because I spent two days on it once trying to find what was the matter with the dynamo. To my satisfaction we had an Edison expert come to the place and he spent some time in trying to find it out also. Finally he remembered.

The next subject I want to speak of and partly illustrate is the application of motors to driving machinery. The great advantage of that system lies in the fact that any other means of transmission requires a very large amount of power to keep the transmitter in operation; for instance, shafting. An ordinary mill uses over half of its power in driving shafting. I had some tests given to me, made at the factory of the Waltham Watch Company, where they have about 3,000 screw and other small machines—like lathes. They have a 100 horse-power engine. It takes about 100 horse power to run the works, but it took 75 horse-power to drive the same mill on Sunday when every machine was thrown out. They did not turn a spindle, and it took 75 horse-power to just turn the shafts. In some recent electric plants the estimates for motors have been very much cut down, because after they put in the first two motors and dynamos they found it took only about half the power they expected to supply all the machines.

Another advantage of the electric transmission is that when you are running overtime or at night, you can run a very small tool in the remotest part of the shop; for instance, with a donkey engine in the engine room, without running your main engine and without using more than one ampere of current. This is the first step in the application of electricity to power transmission.

The second step is to build the motors directly into the machines themselves. Almost all machinery has been designed to be driven by belting, and it has been modified to some extent to adapt it to the conditions of belting and the belt speed, and a great many advantages can be obtained if you start from the beginning and re-design the machine by laying it out so as to be just suited to a motor. For instance, if you have a spindle running at 2,000 revolutions, instead of having a belt to it around a number of idler pulleys, you can make it directly the spindle of the motor.

I have here an electric drill press. This is what is called a sensitive drill. It was driven by an inch and a half belt, or rather four belts. It was belted over here from two idlers down to a countershaft here, and from here to another countershaft. And all of that paraphernalia has been wiped out by simply putting the armature of the motor right on the spindle of the drill.

That drill requires about a quarter of an ampere to operate it; and before, a quarter horse-power motor with two amperes was scarcely able to drive it with the belting it had. There are a number of electric lathes built now on the same principle, and I think that in two or three years we will all see some very radical changes in the way in which all kinds of factories are equipped. Dispensing with the shafting and belting makes it possible to have a great deal more light and to have the shop a great deal cleaner. You can whitewash the whole shop, and there is nothing to carry dust.

OUR WESTERN LETTER.

The Ansonia Electric Company's accounts are being bought up by Thomas Wallace at 35 cents on the dollar.

Mr. F. J. Hoag, 302 Water street, Toledo, O., has been appointed chairman of the Reading Room Committee of the Toledo Public Library, and proposes to have the leading engineering publications on file.

Mr. Angus S. Hibbard has an article in Armour Institute's magazine on "A Phase of Telephone Engineering," that is an interesting study in telephone traffic, and includes a chart showing the effect of current events upon messages sent by telephone.

A Western Association.—Letters are being sent out from Chicago to central stations in Michigan, Illinois, Iowa, Wisconsin and Minnesota, advising the formation of a Western Electric Light Association, or to join hands with the Northwestern Electrical Association.

Mr. W. R. Pinckard is now in charge of the house goods department of the Central Electric Company, 118 Franklin street, Chicago. Mr. Pinckard's long experience in this line has resulted in a wide acquaintance, all of whom will be glad to learn of his change of address.

The University of Wisconsin's special series of lectures in engineering includes one for March 23 by Mr. C. M. Conradson, of the Gisholt Tool Works, Madison, Wisconsin, on "A Modern Machine Shop." One on April 13, entitled "Modern Electric Light Stations," by L. A. Ferguson, electrical engineer of the Chicago Edison Company; and one on "Electrolysis," by Prof. A. J. Rogers, of Milwaukee, to be delivered April 27.

The Central Electric Company, Chicago, prepared what has been designated as a central station man's calendar, and that the work is appreciated may be inferred from the following letter from an electric light company: "We are obliged to you for your calendar for 1894. We were on the point of writing for one, because it was the most sensible and complete one we had last year, and we hoped you were printing one of the same style for this year."

The Question of Credits.—A large supply dealer recently referred to the very small percentage of accounts that had been charged off to profit and loss in his business, and to the strict injunctions he had given his salesmen not to be too anxious to make sales until an improved condition of affairs is noticeable in the financial market. Where there is a reasonable chance of the account being collected a sale may be made, but unusual care must be exercised in investigating the credit standing of the purchaser before the goods are shipped.

Chicago, March 20. F. DE L.

The Barrows System of Transportation.

A NOVEL METHOD OF CITY AND SUBURBAN TRAVEL.

A system of transportation by light electric carriages on a light and inexpensive elevation has been patented by C. H. Barrows, of Willimantic, Conn. Mr. Barrows claims that any system of electric transit, whether at high or low speed, whether in city or country, to be safe and cheap for its patrons and profitable to its owners must be elevated.

This system can, according to Mr. Barrows, afford to provide an elevation for rapid transit between distant points, anywhere and everywhere, across the country in every direction, at a money cost of one cent per mile, and a great saving in time over any existing system.

An elevation over the general surface of the country requires no cuts or fills, an approximate level and straight line being maintained by longer or shorter posts. It goes above all road and railroad crossings, does not divide farms or offer obstruction to grazing cattle, and but little obstruction to cultivation of the soil, requires no fencing, enhances the value of farming lands, which has the effect of reducing the cost of right of way to a minimum.

The very low cost of a structure for light carriages at 20 miles per hour makes this system available for back country towns that could not furnish business enough for a more expensive line. But this system, while providing for electric railways cheap enough to fit a thousand and one situations that must have a cheap one or none at all, does not by any means confine itself to such situations, but by its different grades provides for three different styles and speeds, from $2,000 per mile and speed at about a three minute clip, up to a four-track substantial steel structure, with very light trains of one motor and one trail car, making an average, from point to point, through the country of 60 miles per hour including stops. And this, in Mr. Barrows opinion, is as fast as it will pay to drive a car. It is easy to talk of 100 miles per hour, but the enormous expense of a structure to withstand the strain, and the immense cost and weight of the driving machinery necessary, would make a commercial failure of the undertaking.

It is very generally admitted that sooner or later the storage battery, as a source of energy for electric traction, must come to the front. The Barrows system seems to open up a new field for the storage battery, as it is peculiarly adapted to it by its light weight vehicles and its light, almost frictionless, driving mechanism, which is entirely new and is said to be superior to the general style of gearing. The accompanying illustration, Fig. 1, shows a general view of truck frame and propelling machinery of a motor car and the track with one rail, as designed for a general carrying business across the country, at a speed of 30 to 40 miles per hour, with 2,000 pounds of battery cells and two five horse power motors.

This size is also appropriate for city and suburban passenger traffic. On a light, open steel structure, supported by light arches over the street, or on single posts along the curb line, this motor is capable of handling two loaded trail cars at the usual speed, under all circumstances.

By means of small spur pinions on the armature shafts, which engage with the sprocket driving chains, the motors apply their whole power directly to the periphery of the driving wheels. The power of a very small fast speed motor utilized in this manner will drive a car that would require a large slow speed motor if geared in the old way.

The broad faced wheels on the cap of the girders, together with the double flanged center wheels on the rail, bite the track with a grip that precludes the possibility of slipping, and every revolution counts.

Each driving drum is provided with a groove, in which is seated a yielding or elastic filling, which affords a soft bearing for the driving chains and increases the frictional contact between the drums and the chains. Directly under the sprocket pinions of the motors are situated adjustable idler pulleys, over which the chains run, and which may be easily adjusted to take up slack in chains and adjust them to the right tension. All the wheels are tight on the shafts, and all turn or stop together.

Fig. 2 shows motor and one trailer for suburban and cross country passenger traffic. For a strictly city business a passenger compartment forward will be provided in place of the inclined front. The small doors indicate the position of battery trays, which are transversely situated and may be changed in 15 seconds. Simply open the doors, draw out the trays, shut the doors and car is ready to start again. While they are being drawn out at one side, new ones are being rolled in from the other side, so that as soon as the old ones are out the new ones are in. Connection is made by automatic spring contacts. The longitudinal girders, a necessary part of any elevated structure, are here utilized as wheel bearings for the broad faced flangeless wheels, and only one steel rail is used, in the center of the track, on which runs the double flanged wheels. The friction being applied to the rails on so large a surface would also decrease the loss of power and speed by slipping.

For elevated roads in cities with a steel supporting structure there seems to be no reason why this system should not receive consideration. The cars are light and low, offering little resistance to the wind, not liable to upset, and easy to get in and out of, and remarkably neat in appearance. The simple propelling machinery, the manner of utilizing the power of small fast speed motors, the light weight of battery necessary to supply the current, the wide track bearings of the low cars are the conditions that make it practicable to use very cheap and very light weight trains on a very economical elevation.

The small cheaply constructed lines branching off from this main line into the country in every direction could be built for a single track, Mr. Barrows claims, at a cost of about $2,000 per mile. The equipment necessary to do the business for such a line, say one motor car with passenger compartment at each end driven by a pair of two horse-power motors and 1,000 pounds of battery cells, 1 trail car for extra occasions and one freight car for about two tons load could all be had for a reasonable sum, and would furnish transportation facilities that would double the value of every farm along the way and make the country available for the homes of thousands of toilers in the city. The saving in rent alone would in a few years pay for a home in the country, and the advantages of a garden, a cow and a few hens would more than pay the car fare, which in this system need not be more than one cent per mile.

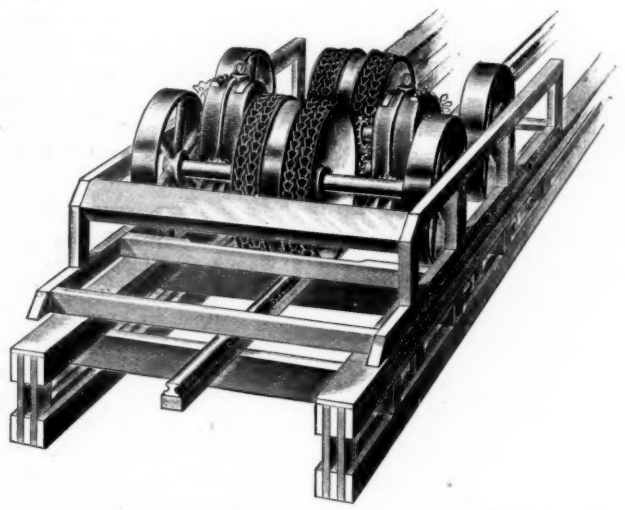

FIG. 1.—THE BARROWS TRANSPORTATION SYSTEM.—GENERAL VIEW OF TRUCK FRAME AND PROPELLING DEVICES OF MOTOR CAR AND ONE RAIL TRACK.

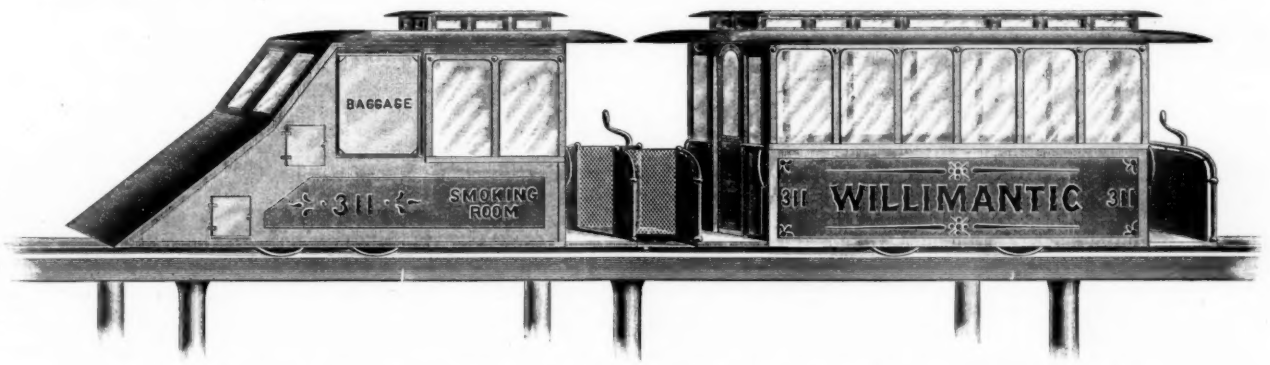

FIG. 2.—THE BARROWS SYSTEM OF TRANSPORTATION.—SHOWING MOTOR CAR AND ONE TRAILER FOR SUBURBAN TRAFFIC.

Long-Distance Telephoning Between Germany and Denmark.

The Danish Government has given its approval to the proposal of the German Postal and Telegraph Department to establish telephonic communication between Berlin and Copenhagen, provided the line shall pass through the town of Odense. The line would then form part of a trunk between Odense, Kolding, Hamburg and Berlin.

Electric Traction in Norway.

The electric street railway in Christiania is now completed and was put in operation a few days ago.

The Antwerp International Exposition.

At a meeting of the members from New York, of the United States Honorary Commissioners to the Antwerp International Exposition, held at their offices, 14 and 16 Church street, New York city, on Wednesday, March 14, it was resolved to again call the attention of American manufacturers and producers to the fact that the Antwerp Exposition will open promptly on the fifth of May next. This is assured, as all the main buildings of the exposition are now completed. Intending exhibitors (and especially those from the State of New York) are urged to make their applications for spaces or concessions immediately; if possible, before April 1, at the New York headquarters.

For our manufacturers and producers who are now seeking the markets, not only of Continental Europe, but of Latin America and Australia, exceptional opportunities can be had at the Antwerp Exposition for placing the samples of their goods before the buyers from these markets, because this is a business Exposition.

The representatives of the Honorary United States Commission will (where such services are required) have the general supervision of the reception and care of exhibits during the term of the Exhibition. Exhibits should be ready for shipment not later than April 10. Special low rates of shipments to the Exposition direct have been obtained. For further particulars apply to the New York headquarters, Antwerp Exposition, 14 and 16 Church street, New York city, T. A. Matthews, commissioner.

The Largest Electric Railway Contract.

The contract given last week by the Nassau Electric Railroad Company, of Brooklyn, N. Y., to W. A. Boland, of Boston, for the construction of 100 miles of electric street railway in Brooklyn and nearby towns, and awarded by him to the Johnson Rail Company, of Johnstown, Pa., is the largest street railway contract ever made.

Mr. Boland receives $3,000,000 in common stock of the road and $6,000,000 in five per cent. 50 year bonds, and pays the Johnson company with stock and bonds.

Mr. Boland is reported as saying: "We expect to pay the fixed charges on our bonds from the beginning of operation, and in 1895 a reasonable dividend on the stock, but, of course, cannot give any idea as to amount. The contract for the electrical equipment has not been made, but it is probable that it will be divided among the Thomson-Houston, Westinghouse and other smaller companies.

"The road will be double-tracked throughout, and the first section of 15 miles of double track will be completed by July 15 and the remainder during this year. Construction work will begin immediately and a portion of the rails are now on the ground. About one-half of the road will be in the city and the remainder in the nearby towns.

"R. T. Wilson, of New York, will take several millions of the stock and bonds. It is not probable that either our stocks or bonds will be listed on the Stock Exchange, as the people who have subscribed for them have done so for a permanent investment.

"Practically all our right of way has been secured. The rails will be electrically welded. There will be a power house in Brooklyn provided with five 1,000 horse-power Corliss engines and another in the country will have 10 Corliss engines, having a combined horse-power of 7,500.

"We are going to try the experiment of running some drawing-room cars in which double fare will be charged, and no more people than can be seated will be carried in these cars."

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 2339. NEW YORK.

EDITOR:
CHARLES W. PRICE.

ASSOCIATE EDITOR:
STEPHEN L. COLES.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.

1546 "CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
H. G. TUCKERMAN, Room 29, 620 Atlantic Ave.

CHICAGO OFFICE:
FRED. De LAND, 436 "The Rookery."

WASHINGTON OFFICE:
GEO. C. MAYNARD, 800 H St., N. W.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy, - - - - - - - .10

NEW YORK, MARCH 28, 1894.

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Keep your eye on the city of Cleveland.

Mr. Boland, of Boston, is evidently a far-seeing gentleman.

The loudest talkers against the value of advertising are the most covert and assiduous in their efforts to get it for nothing.

There is a growing field for storage batteries in telephone central offices. In replacing the old Callaud batteries, the storage battery becomes a distinct and agreeable step in advance.

The company that expects to supply telephone service satisfactorily at $2 a month, patents or no patents, has undertaken a job of philanthropy. This may not be of popular belief, but it is a congealed fact.

A 200 arc light dynamo may be seen in daily use at the factory of the Excelsior Electric Company in Brooklyn. The station men of the Washington Electric Light Convention who wanted large dynamos might find it to their interest to drop in and see Electrician Hochhausen.

There is quite an opening in the electrical field for a long-felt-want-filling paper. We know this must be so, for there hasn't been a new one started for two weeks.

The theater that is not lighted by electricity is far behind the times. Health and safety demand that all buildings where the public gather in large assemblies should be thus lighted. This is an old story for the electrical press to harp on, but one that cannot be brought to the attention of the public too often.

The National Statistical Association, of Washington, D. C., of which Mr. Allen R. Foote is vice president and manager, is sending out blanks to central station electric lighting companies asking for information, prices and data on street lighting. The utility of complete and reliable data on this subject is apparent and it is hoped that Mr. Foote will be fully successful in his attempt to get this information.

John H. Packer, of Topeka, Kan., writes, "When my subscription expires please let me know and I will renew. I cannot get along without my ELECTRICAL REVIEW." There are a great many thousands, we are pleased to say, who have the same regard for the ELECTRICAL REVIEW that Mr. Packer has. The one highly encouraging feature about these hard times is the constant increase of paying subscribers to the ELECTRICAL REVIEW.

It is understood that Secretary E. I. Garfield, of the General Electric Company, tendered his resignation to President Coffin several months ago. It is presumed that the resignation will be accepted at the annual meeting next month. Mr. Garfield has always been a conscientious and capable official, probably possesses a wider acquaintance among central stations than any person connected with electric lighting, and should he retire from the General Electric Company will carry with him the sincere well wishes of hosts of friends.

In an editorial entitled "Why the Trolley is Tolerated," the Chicago *Herald* remarks:

Two systems have already been tried. Mr. Yerkes experimented with the Love system and abandoned it. The Siemens system has been given a trial in Germany, and it has proved a failure also. But the germ of the problem has been discovered. Inventors use past failures as guides to future success, and it will not be long before the coming system—the motive power of the cities and, perhaps, of the country also—will be perfected and in operation.

The editor should take a ride over the German road, and also over the one in Washington, and learn a point or two.

One of the most promising fields for electrical development is the generation and distribution of electric current from water-falls and artesian wells. There are literally thousands of horse-power going to waste because, heretofore, there has been no economical means of utilizing water-power. Turbine wheels, which in the past have felt the competition of the steam engine, here find a proper place and their sale must increase in direct proportion to the number of water-power electric plants established. There are several stations now operating by power from artesian wells and there will undoubtedly be many more.

ELECTRIC SPEED.

The regulation of the speed of electric cars is always a question of interest. It is undoubtedly true that the great majority favor the most rapid transit obtainable. The following pertinent and sensible remarks on this topic are taken from the *Utica Press*, of this State:

When a man is in a hurry to catch a train, to meet an appointment or get home to dinner, he criticises the management for running its cars so slowly, and says that the subtle fluid is slower than old-time horses. When the same car runs more swiftly, carries its passengers more rapidly and bumps into somebody or something, injuring a wagon or an individual, then the public holds up its hands and says that the cars run too fast anyway, and there should be some rule to prevent high rates of speed in streets. With the desire of making legislation for every possible subject under the sun, Senator Coggeshall has a bill which says that electric cars shall not go faster than six miles an hour. The horses used to go as swiftly as that, and one of the advantages from the introduction of electricity on surface railways is the saving in time between two points. In these later days of American enterprise, time is looked upon as money, and every business man, as well as almost everyone else, wants to spend as little time in transit as possible. The fast trains on the steam roads pay the best.

There are, doubtless, very many in Utica, for instance, who do not wish the electric cars to run any more slowly than they do, and, perhaps, some would like to see them going at a snail's pace. It would seem that this is a matter which could be better regulated by the several cities where the lines are located rather than by general legislation enforced throughout the State. The common council has power to regulate the speed of electric cars through its streets, and if the people of one city wish them to go at six miles an hour and those of another are willing that they should go faster, it is better to leave the matter where both can be pleased rather than to make an arbitrary rule applicable everywhere.

The leading article in the latest number of the "Proceedings of the United States Naval Institute" is entitled "Notes on Naval Dynamo Machinery," by Lieut. J. B. Murdock, U. S. N. The article is well illustrated and altogether interesting. The author's conclusions, after an inspection of the systems and electrical apparatus in use in the different European navies in 1891, followed by duty at the New York Navy Yard, where the electrical plants of nearly all the vessels of the navy have come under his inspection, are that our electrical plants are in most respects superior to those in use in other navies, but deteriorate more rapidly.

The Governor of the State and the Mayor of Brooklyn met by chance in Albany recently. Behold! the chief topic was electricity and its adaptability to the canals of the State. Both of these gentlemen are well informed in this art; but as Mayor Schieren, of Brooklyn, has been a reader of the ELECTRICAL REVIEW longer than Governor Flower, we think the former could give the latter several points in the discussion.

The wide-awake New York *Evening Sun* in its first edition on Friday last remarked:

"On a review of the whole field, the ELECTRICAL REVIEW's forecast is not unlikely to be fulfilled, namely, that 1894 is to prove a great year in the development of electric traction."

1894 will be a great year in all branches of electricity. Immense strides will be made in power circles.

CORRESPONDENCE.

OUR BOSTON LETTER.

The City of Boston is now getting its street lighting done for 35 cents per light, under a guarantee to use at least 2,000 lights.

A Company has been organized at Portland, Me., with a capital stock of $500,000, for the manufacture of all kinds of electrical and mechanical motors and appliances. It will be known as the Electric Power Company, and the officers are E. A. Clark, of Boston, president, and E. C. Ramsdell, of Cambridge, treasurer.

The Display Made by the W. S. Hill Electric Company, of this city, during the recent Convention at Washington, was far and away the best of anything in their line. The exhibit was looked after by General Manager Geo. H. Poor, and it is safe to say that the delegates who failed to find out that he was in town were very few.

The Standard Electric Time Company, of New Haven, Conn., has been purchased by Waterbury capitalists and reorganized. S. E. Judd is president and C. D. Warner, who has been so long and prominently identified with the concern, is treasurer. The business will be pushed vigorously under the new management.

W. B. Southgate Company is the title of a new firm, with offices at 146 Franklin street, who have started in as manufacturers' agents, and will handle, in that capacity, everything in the electrical line in this territory. Mr. Southgate was formerly connected with the Whitney Electric Instrument Company, and is well known in Boston.

L. A. Chase & Company, 161 Fort Hill Square, is another comparatively new concern who are doing a good business. Besides the manufacture of all kinds of dies, punches, tools and experimental apparatus, they make a specialty of inspecting and repairing motors and dynamos, in which line they have already built up a good business.

The Davidson Ventilating Fan Company, of this city, are gradually working more and more into the electrical line, and intend making this department a special feature of their business. Among other things they have secured the sole New England agency for the Meston alternating current fan motor, of which they will carry a full line. They are also doing considerable construction work, and have recently installed a very complete electric plant on board the United States training ship "Enterprise."

The Announcement that the West End Street Railway Company has just closed a contract with the Westinghouse Electric and Manufacturing Company for some 200 motors needed for the equipment of its open cars has occasioned considerable interest in electrical circles, as its previous contracts for electrical equipment have been given to the General Electric Company. This successful incursion into the field of the General Electric Company is looked upon as especially significant at this time, and is taken as evidence that an aggressive fight is to be made for New England business by the Pittsburgh concern. It was learned that at the outset a five years' contract was given the old Thomson-Houston company by the West End, and since its expiration the prejudices of the railway officials were very naturally in favor of that concern, so that it has been impossible for any others to make any headway in the matter of supplying its needs. Recently, however, the Westinghouse company has brought out a new motor, designated as No. 12, for street railway cars, which it has been pushing upon the attention of the interested parties throughout the country until they have been introduced into many of the more recently equipped plants. A trial of this motor has been going on under the direction of the West End company for the last month in competition with those of other makers, with the result that the contract was awarded as above stated on account, in brief, of the economy of the new motor, its adaptability to the needs of the West End company, and the ease with which it adapts itself to the variable loads carried by its cars. The new motor is of the multipolar type, having four pole pieces and four field coils. The armature is of the drum type, with a grooved surface, and the armature winding is done with machine wound coils which fit into the grooves in the core. Perhaps the most striking feature of the motor, at least when first seen in position on a truck, is the method of suspension employed. This method relieves the axle from not only a part, but practically the whole of the direct weight of the motor, and consequently relieves the track from what has been termed the "hammering action." All side motion is guarded against when the car is passing over rough places in the track. By reason of the improvements which have been introduced, and by a more efficient utilization of the iron in the fields and armature, and of copper in the windings, it has been possible to effect a material reduction in the weight of this motor. This has, however, been done, it is claimed, only so far as it is consistent with a margin of mechanical strength adequate to meet the severe conditions of electric traction. The motor is thoroughly self-protective from dust and water. The lower half of the fields is in the form of a bowl without openings, except at each side just under the armature bearings, these openings being closed by water-tight covers, which on removal give access to the interior for purpose of inspection. Provision is made for rapid yet thorough examination of the armature and field coils as follows: The lower half of the fields is hinged to the upper half at the end farthest from the axle. The armature bushings are carried in pillow blocks which, when the motor is closed, are secured to both the upper and the lower fields. By removing the proper bolts these pillow blocks may be forced from either of these connections and the armature be allowed to remain fastened to one or the other half of the fields as may be desired. Among other New England contracts is one awarded by the Springfield Street Railway Company, which is about erecting a power house to supply its own power, which it has obtained heretofore from the electric light company of that city. In making the change the new equipments of the Westinghouse company are to be adopted. Equipments have also been furnished to the street railway companies at Gloucester, New Haven, Hartford, Clinton, Fitchburg and Leominster, and there is evidently a better outlook for the street railway business than was the case a short time ago. H. G. T.

Boston, March 24.

OUR CHICAGO LETTER.

The National Electric Company will occupy handsome offices in the Old Colony building early in April.

Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Company, was a Chicago visitor this week.

The Western Electric Company is employing its usual season force of 1,000 hands, and have an abundance of future work in sight.

Mr. C. O. Billow, the oil fuel contractor, reports an increase in business during the past month that has nearly swamped his office.

"Nature Smiles Through Sunbeams," is the very expressive way in which Mr. F. S. Terry is calling attention to the new Sunbeam lamp.

The Wallace Electric Company will occupy the storerooms vacated by the Metropolitan Electric Company, on the ground floor of the Manhattan Building.

Mr. Arthur Dee, of Taylor, Dee & Mack, is pleased with the decided increase in the volume of business they have recorded during the past four weeks, and does not believe that it is a temporary spurt.

The North Side "L."—Mr. Louderback states that the line will start on Wabash avenue between Madison and Monroe, run west in the alley to the cross alley between Dearborn street and Fifth avenue, and then turn north.

The Lake View Rapid Transit Club now proposes to introduce a storage battery system on a projected line to connect Ravenswood, Jefferson and Lake View. Like all the other impracticable schemes projected in the fertile region of North Clark street, this will soon be forgotten.

Pierce & Richardson, the new electrical engineering and contracting firm, are meeting with success. Mr. Pierce is in California at present, and Mr. Richardson is looking after the home interests from the headquarters in the Manhattan Building. Notwithstanding the hard times, few firms start out with as good prospects or with a higher reputation for honest and efficient management.

Chicago, March 24. F. De L.

Sad Accident to Mr. John L. Martin.

Mr. John L. Martin, of Chicago, met with a serious accident Thursday evening which came near resulting in his death. Mr. Martin was at the Sixtieth street station waiting for a friend, the two intending to take a downtown train for Chicago city. A train was passing when Mr. Martin, who was standing near the edge of the platform, suddenly slipped and fell under the wheels. He put out his left hand to prevent himself from going under the train, and the arm was cut off just below the elbow. Mr. Martin is a member of the firm of Horne & Martin, the general sales agents of the National Electric Company, and was formerly with the Thomson-Houston and General Electric companies. About a year ago Mr. Martin was struck by an Illinois Central train at Hyde Park station and escaped death almost miraculously. In neither case was there anything which could be called carelessness on his part. This latter was the accident in which Mr. Davidson, of Port Huron, was so severely injured.

Lost, Two Contracts. Found, One Salesman.

The General Electric Company having lost a large contract for railroad equipments in Brooklyn and another large one in Boston feels a little hurt. "Billy" Clark, who was recently transferred to the Cincinnati office of the General Electric Company, was not on hand and so the contracts were lost. Last Friday, about 11.45 P. M., Mr. Clark was seen escorting Mr. Charles A. Coffin to a cab in front of the Imperial Hotel, in New York city. Curiously, this was the night after the big West End contract in Boston had been awarded to the Westinghouse Electric and Manufacturing Company.

The Fence was Lined with Electrical Spectators.

A hotly-contested horse race occurred on a Saturday afternoon recently at Passaic, N. J., at which all the witnesses were the employés of the Okonite Company, whose large factory is located at that point. The race was to decide a long standing dispute as to whether "Garfield Bell" or "Daisy" was the better horse. The former proved to be, according to the time kept by one of the new Okonite clocks. The wager was a dinner, afterwards enjoyed at the Delawana hotel, at which H. Dwight Stanley acted as toastmaster. Everybody had a highly enjoyable time.

PERSONAL.

Prof. E. J. Houston delivered a lecture on "The Future of Electricity" before the central branch of the Young Men's Christian Association at Philadelphia on March 22.

Major Geo. W. La Rue, of New Haven, Conn., was a New York visitor last week. Major La Rue is engaged in the electric elevator business and is much pleased with the success of the apparatus now being manufactured.

Mr. W. W. Nicholson, of Utica, N. Y., general superintendent of the Central New York Telephone and Telegraph Company, was a New York visitor last week, arranging for storage battery installations in his different exchanges. Mr. Nicholson reports an increase in the demand for telephones in his territory.

A fire in the station of the United Light and Power Company, New York, on Monday morning of this week, caused a loss of about $15,000. A temporary stoppage of the supply of electric light resulted.

Wall Street and the Electrical Stock Market.

The market this week was decidedly of the bull order, being a continuation of last week's movement. The checks to the upward movement were the uncertainty of the President's attitude toward the Bland Seigniorage Bill and the high rate of sterling exchange. Despite these two factors, Europe bought considerable quantities of stock, hardening the general railroad list and advancing some of the more active stocks to the highest prices of the year. The general public is commencing to take a little interest in the market. The advance has been gradual and steady, with the minimum reaction, and it looks to me as if it would for the most part hold. Should the President veto the Seigniorage Bill and the Senate settle the tariff issue one way or the other, the market would set in for a steady advance. The uncertainty on the tariff attitude is killing business, which in turn acts like a wet blanket on Wall street.

The change in the quotations of electrical securities for the week was but slight, with an upward tendency. There is considerable interest in General Electric, reflecting more or less activity. A story is in circulation to the effect that a new bull pool has formed in the stock and that it will be advanced still further. I do not look for any material change until after the annual meeting, when it will be determined to what extent the capital is impaired and what measures are to be taken to remedy the same. Under the law of the State of New York, which granted General Electric its charter, it is a misdemeanor to pay dividends when the capital is impaired.

The range of the stock was as follows: Highest, 43½; lowest, 42. The preferred stock in Boston was quoted at 75; lowest, 72.

An exchange which claims that Westinghouse and General Electric are each doing about the same gross business, publishes the following table of capitalization:

	Westinghouse.	Gen. Electric.
Bonds	$692,000	$10,000,000
Preferred stock	3,600,000	4,000,000
Common stock	5,400,000	30,000,000
Total capital	$9,692,000	$44,000,000

President Wetmore says that the North American company is negotiating the sale of $2,000,000 bonds of the Milwaukee Street Railway Company. The system has been completed and the bonds are issued against the property. He thinks it is only a question of time before the negotiations terminate in a sale. The proceeds will discharge the floating debt of the North American company and release certain securities now held as collateral.

Mexican Telephone Company shows net earnings for the year of $57,03?, an increase of $14,625.

On the Boston Exchange the following stocks are quoted: Fort Wayne Electric, 3½ to 5; Westinghouse Electric, first preferred, 49, bid to 49¼; assenting 32 to 32¼; American Bell was quoted at 182 to 183; Erie Telephone, 44¼; and New England Telephone, 50 to 51. Bain.

New York, March 24.

New York Electrical Society.

To the Editor of Electrical Review:

I am directed by the president of the New York Electrical Society to thank you for the prominence given by the Electrical Review to the meetings of the society, and especially for your excellent report of the last meeting on the 15th inst. The society is much indebted to the electrical press generally for the generous recognition which has been given of its efforts to widen the scope of its work, and such notices as the Electrical Review has at various times published are highly appreciated, as they are really helpful. Indeed, it gives me much pleasure to have this opportunity of stating the fact that during the last two months I can trace the election of several new members directly to the influence of the Electrical Review.

Yours truly,

George H. Guy, Secretary.

New York, March 23.

OBITUARY.

Philip Herzog, secretary and treasurer of the Herzog Teleseme Company, died at his residence in New York city on March 21 after several months' illness. He was the father of F. Benedict Herzog, the inventor of the telesemie system.

Notes of a Trip to the United States and to Chicago—1893.

READ BEFORE THE INSTITUTION OF ELECTRICAL ENGINEERS, LONDON, JANUARY 25, 1894, BY W. H. PREECE, C.B., F.R.S., PAST PRESIDENT.

(*Concluded from page 142.*)

IV.—THE EXHIBITION.

Nothing grander in design or more beautiful in execution has ever been seen in this world than the group of buildings situated in Jackson Park, Chicago, and called the "World's Fair." It is a great misfortune that the world did not appreciate, nor respond to, the ambitious views of the conveners of this fair. Their conception was magnificent. Their architects, if they did not originate the plans, certainly rose to the occasion. Their builders realized their views. Every possible convenience and accommodation was provided for exhibitors, but the response was poor; and the internal management of the whole business, owing to inexperience and perhaps overweening confidence, was indifferent. The success of the undertaking hovered for some time over failure; but fine weather, patriotism, novelty, real beauty and cheap fares at last attracted crowds, which, numbering about 200,000 a day, have converted what looked like a disaster into a well-deserved success. I have not much to say of the Exhibition as an exhibition. It was very like its predecessors. It did not attract me; for, having taken part in nearly every exhibition for the last 15 years, I am sick of exhibitions. I devoted much attention to the electricity building, and observed there several novelties, some of which I have referred to in other parts of this report.

Gray's telautograph attracted much attention. It is an improvement on Cowper's writing telegraph. It reproduces the motion of a pen, so that while you are writing in London a phantom hand seems to guide the pen and reproduce your own writing in Nottingham. You can see the pen move, dot the i's and cross the t's. It makes corrections and erasures. It works well, but very weirdly. My writing and signature were clearly reproduced at the very first trial. But it is immature for practical trial at present. It has not reached its final stage. It is being improved every day. It is very complicated in construction, and it requires four wires to work it. The Western Union company in Chicago have established a circuit between their head office and stores department, and are giving it a good test.

The French and German administrations sent admirable and extensive displays of their historical and working apparatus, with a very large staff of men to attend to them, but I am pleased to say that our postoffice exhibit proved much more attractive and interesting. It was better arranged and more complete; and our one solitary assistant, Mr. J. Chapman, won golden opinions by the admirable way in which he attended to his duties, and by the excellent verbal explanations he gave of our show.

The United States of America made no historic exhibit, but the Western Union company showed many relics and examples of Morse's early work.

The American public were surprised to find how much we in England had anticipated their work. Morse's first message, "What has God wrought?" was sent only in 1844. Our history commenced in 1837. Our jubilee was celebrated in 1887. Theirs is to be celebrated this year.

An exhibit that attracted much attention was a door which opened before you as you approached it, and closed behind you as you receded from it. This was done by a small electric motor which was set in motion when you stepped on a mat, and released when you passed through the door. It was worked with the same current that would light a glow lamp.

Both on entering the harbor of New York, and on going by steamer from Chicago to the World's Fair, channels for the passage of the steamship were clearly marked out at night by glow lamps fixed on spar buoys and lighted up in series.

There was shown an electric selector of great merit and some originality. It was a plan by which any particular railway station could be selected and called, any particular signal cleared or put to danger, any office on a long circuit with several intermediate instruments selected and secured, any subscriber on a combination telephone circuit—that is, on a single circuit upon which several renters are fixed—could be called and isolated from the rest.

All the great manufacturers in the United States made large exhibits of their wares. The American Bell Telephone Company, the Western Electric Manufacturing Company, the General Electric Company, the Westinghouse Company, the Standard Electric Company, had splendid shows, but few novelties. Their novelties have already been referred to, either under electric lighting or electric railways.

Electric lifts were on exhibition and in use. They worked very well indeed, and are rapidly coming into general use in the States. The New Postal Telegraph Building in New York is being fitted with several of these lifts, which are going to be worked very quickly indeed (600 feet a minute). They are being installed by the Sprague company.

Electric welding was shown in full operation and attracted much attention.

Power was transmitted all over the place by currents, and whole exhibits were shown in motion by means of electric motors.

Along the machinery hall, 1,400 feet in length, an electric crane, 75 feet span, traveled and formed an admirable point of observation for those who were allowed to travel on it. It was used in the preparation of the exhibition to lift and fix all the machinery. It lifts and moves 40 tons. It is worked by five motors. Its weight is 58 tons, and its speed was excellent.

There were large exhibits of every class of cable manufactured in the States—Waring, Okonite, Kerite, Patterson, Dry-core, etc.; and Felton & Guilleaume had in the German section a fine show of their own make. Sections of streets were shown with pavement, manhole, conduits, joints and everything complete.

England is the home of the alternator, but it has now taken firm root in America. In 1884 there was not a single one to be found in Philadelphia. Now they are everywhere, and alternate currents are being studied and developed in a way that is completely putting our experimentalists in the back row.

The paucity of real novelties, or of what are commonly known as "Yankee notions," was very marked. The necessity for such things, that is, the scarcity of labor, has apparently disappeared, and with its parent the child has languished. Moore's spark interrupter—an automatic vibrating armature in a vacuum tube, by which glow lamps can be turned up or down without wasting energy—was described at a meeting of the electrical engineers at New York, but I did not see it at the World's Fair.

The distinguishing feature of the Chicago World's Fair was not alone its uniqueness, but its grandeur and its magnificence. It was not an exhibition of goods and manufactures in the Old World sense. No one seemed to care two straws for the mere trade exhibition *per se*; he admired the beautiful buildings, the water-ways, the external attractions, and, above all, the congeries of people that assembled from all quarters of that great continent in such multitudes.

The distinguishing feature of American engineering is the great scale on which it is carried out, and the rapidity of its adoption. An electric railway from Chicago to St. Louis, 250 miles long, is not a difficult engineering feat, for the country is level, but it is novel for the fact that it is projected to travel at the rate of 100 miles an hour.

There were some things in the Exhibition that were extremely interesting. The first was a complete reproduction of an ancient Vikings's war-ship, an open boat, that would excite fear and trembling even in crossing the Channel, but of a type that probably crossed the Atlantic long before the famous fleet of Columbus. These vessels, the "Santa Maria," "Pinta," and "Nina," were also reproduced in all their dimensions, and in all their colors and fittings. The contrast between these relics of the past and the modern war ship built alongside the home of the British Commission, Victoria House, was, to my mind, more suggestive than all the innumerable wares and appliances so freely exposed in the vast extent of covered area.

One interesting building was a kind of baby cloak room, where mothers could book their babies for the day, and who were there carefully tended, nursed, amused and fed for a very small charge. Each mother received a small brass check, which was her guarantee for the safe custody of her little beauty.

V.—ELECTRIC LIGHTING.

Electric lighting has not generally made the rapid progress during the past nine years in the States that was expected from its great rate of growth during the previous four years. Wild speculation, hasty construction, fatal accidents and frequent failures have reacted on steady progress. At the same time the advance has been very great, principally in public street lighting. All towns and villages in all parts of the country, however small and isolated, or however distant, seem to have adopted public arc lighting. Arc lamps are found suspended over the roadways in a very rough-and-ready way, sometimes from stretched wires, sometimes from long balanced levers, but always effective.

The arc lamp-posts are generally of timber, like telegraph poles; occasionally squared timber, as in Broadway, New York; and sometimes plain and neat iron poles, made of differing sections of iron pipes, but rarely so heavy, massive, artistic and expensive as in England. Clear glass globes appear to be almost universal in use. It is quite rare to see frosted glass or opaline shades.

The principal novelty introduced has been the use of flat carbons of oval or elliptic section, to increase the duration of the light. They are 310 millimetres long; the major axis is 25 millimetres and the minor 11 millimetres. The ordinary arc lamp burns as a rule only eight hours, but this flat carbon doubles its life. Moreover, the flat carbon is found very advantageous and useful with alternating current systems, on which arc lamps as a rule work badly. The standard current used is 10 amperes, and the energy expended varies from 400 to 500 watts. The lamps burn very steadily as a rule and give a light of about 800 candles at the angle of maximum intensity.

An excellent self-regulating alternator for public arc lighting, designed by Stanley, was exhibited by the Westinghouse company. It maintained its current quite constant, however much the number of the lamps was varied, between 0 and 24. Any number could be turned on or off without the least difference being detected in the current on the light.

The favorite arc dynamo in the States is said to be that supplied by the Standard Electric Light Company. There was a large exhibit, six machines, of this type in the Exhibition. The largest size worked with 6,550 volts, and maintained 120 arcs in series. It is fitted with a very effective and rapid working automatic governor, regulating the range of the brushes so that as lamps were turned off the current was maintained constant and the voltage changed. Six seconds only were needed to regulate the brushes from a load of one lamp to 50 lamps.

Arc lighting is used very much for shop lighting, not only in the interior for general illumination, but for advertising and attractive purposes outside. Indeed, many of the streets of the principal cities, especially New York and Chicago, are more brilliantly lighted by the shopkeepers than by the municipalities. In fact, in many cities there are many more arcs supplied for private than for public purposes.

Incandescent Lighting.

Glow lamps are, within my observation, invariably used in telegraph offices, post-offices, telephone exchange rooms, hotels and in many railway stations.

The electric light is more general in such public places than with us. I did not visit a single place that was not so fitted, and with glow lamps. In private houses it is much used, but not so generally as with us. In Chicago the residential lighting is only 33 per cent. of the total. In all large cities there are immense blocks of buildings fitted with lifts and used as offices. In all cases they were lighted by their own isolated plants. One of the most striking features of a great city like New York or Chicago is the white, fleecy, wool-like jets of vapor that float gracefully away from the top of every large building. They are to be reckoned by the hundred, and every one means steam plant working lifts and electric light. The Western Union company at New York and Chicago have their own steam plants.

When I visited Chicago in 1884 no central electric lighting station had been built and no current was supplied. Now, a capital of $2,233,000 earns an income of $320,000 yearly.

The glow lamps (16 candle-power) fixed are	136,409
Arc lamps fixed	4,376
Motors supplied, total horse-power,	3,612

and this is equivalent to 430,000 ten candle-power lamps fixed, or such lamps as we reckon with in England.

The maximum load is 50 per cent. of these lamps alight at one time, which accords with our experience in England.

The price works out at 7½*d.* per kilowatt hour or supply unit, and this includes the cost of the renewal of the lamp. The cost of production works out at 3¼*d.* per unit. The cost of the production of electric energy in the States differs, therefore, very little from that experienced here. It is everywhere steadily on the decrease. As the load increases, as the daily supply lengthens in duration, as the generators increase in size, so will the cost diminish; and how low it will fall no one can predicate. Anyway, it will certainly far exceed in economy the production of gas.

The price of lamps to the undertaker—that is, to the electric light company—is 1*s.* 4*d.*; the life of the lamp is 600 hours. A 16 candle-power lamp takes 0.45 amperes and 110 volts. It is, therefore, a 50 watt lamp, and a better one than we get at present in England. The screw socket appears to be in universal use. I wish it were so here.

There are three central stations in Chicago. A new station is being built alongside the water in Harrison street with a capacity for utilizing 20,000 horse-power, where every modern appliance for cheap fuel, automatic feeding, condensing and economizing will be used.

The south side central station is worked by natural gas which is brought in pipes 100 miles long from Indiana. It is very cheap compared with coal.

I found in use in Chicago a system of raising the voltage on the feeders when the pressure falls, owing to the increase of load, by switching in motor dynamos. They have given the name of "boosters" to these instruments. A somewhat similar system has been applied at home, at the Midland Railway, Derby.

The exhibition and its surroundings were, of course, brilliantly and entirely lighted by electricity.

The accumulator in America has been a failure for electric lighting, and a very strong prejudice exists against its use. It has led to much litigation, and the best forms seem little known there. The lagoons of the World's Fair grounds were, however, very successfully navigated by extremely pretty electric launches, worked and lighted by accumulators. The grounds at night, brilliantly illuminated and interlaced by winding water-ways, with wooded islands and pretty bridges, along which illuminated gondolas and silent launches floated noiselessly, formed most beautiful and fairy-like scenes, superior to anything seen in Venice or pictured by art.

The feature that distinguishes American from English engineering practice is the persistent use of belting and countershafting. In some stations the belting was to English eyes appalling. Direct driving is only now making its way. There were several direct-driven engines and dynamos exhibited in the American section at the World's Fair, and some new stations now being built are to be direct-driven. The Willans & Robinson engines on show at the exhibition, and a steam turbine exhibited in the Swedish section by Laval—a form somewhat similar to that of the Hon. Charles Parsons, who unfortunately did not exhibit—attracted much attention. The reports of our performances in England are much sought after, and I think one influence of the Chicago gathering will be to convert American engineers to direct driving.

The elastic character of direct-driving engines, gradually increasing in number and capacity with the load, and the ability to shut down or turn on engine after engine as the load varies, are economical advantages of immense value. The rapid regulation of small engines, the much smaller space occupied where space is so valuable, the smaller capital expenditure involved, and the reduced working expenses, all give direct driving an advantage which should recommend itself to such eminently practical engineers as the Americans.

The General Electric Company showed in the World's Fair a 1,000 horse-power triple expansion vertical marine type engine, driving two 400 Kilowatt multipolar dynamos, and the Chicago Edison Electric Light Company are fitting up their new central station with such direct driving engines.

No one would continue to make huge dynamos with a speed of 90 revolutions per minute when convinced that smaller instruments of the same power may be run with equal economy and success at 350 revolutions per minute.

The town work at such places as New York, Boston and Chicago is as solid and substantial as anything we can show in England; but when we inspect the outlying works in country towns we can only express our thanks that we have the control of the Board of Trade and the protection of an Act of Parliament. It is the fashion to decry grandmotherly government, and to wince at departmental espionage; but the protection of life on our railways, the absence of accident in our electric light undertakings, and the character of the work done everywhere, as compared with the same conditions in the States, can lead to but one conclusion—viz., that if we are slower, we do these things better, at least, in England.

It is all very well in the pioneer stage of industry to let private enterprise have its full swing, but when an industry becomes a public necessity, and when the interests of the whole community are at stake, government, as the custodians of the public weal, must step in and assume the control. The accidents in the States are terrible in their number and fatality; and they strike the observant Englishman with dismay. The value of life there seems to be very much below par.

VI.—ELECTRIC RAILWAYS.

The progress made in the establishment of electric railways is the most wonderful instance of growth of electric industry observable in the States. In 1884 I found only one railway so worked, and that experimentally, at Cleveland. Now every town has its electric railway. There are 4,000 miles of line so worked, 6,900 motor cars and 4,000 trailing cars.* The capital embarked is $13,000,000, and the rate of progress is scarcely checked by the serious financial depression that has passed over the country.

Electrical appliances of all kinds for railway working were among the most conspicuous exhibits at the World's Fair. A special track was laid down for test and

*Trailing cars are not fitted with motors. They carry passengers only, and are drawn by motor cars.

trial, and alone here I inspected a 30 ton locomotive, the heaviest yet made, having a horizontal pull on the level of 6,000 pounds, or enough to draw 500 tons on an ordinary English railway.

The type of railway in general use over the United States of America is very uniform. We have only one true example in England, and that is at Leeds. A modification of the system has, however, been adopted on the South Staffordshire tramways, and is about to be introduced in Coventry. The wires are all overhead. A heavy insulated copper wire is suspended over the center of each pair of rails or "track," and called the "trolley" wire. This conveys the current from the power house. It is picked up by a trolley rod which presses, by the action of a spring, upon this wire, and so conveys the current to the motors, which are geared to each of the two wheel shafts of the car. The current is then transmitted through the wheels to the rails, and it returns thence to the power house by heavy copper returns buried in the ground or suspended on the poles.

There were two very fine specimens of electric railways in Chicago. One, the intramural railway, conveying visitors to and from different parts of the grounds of the World's Fair, working very well, carrying an immense number of people, and financially very successful. It is not a trolley line, but it has a third rail acting as the main conductor. The other is the Chicago North Shore Street Railway, running to Evanstown. This is a trolley line having iron poles of strong design and good taste. It is seven and a half miles long, with a power house situated in the middle of the line. It has 16 motor cars and 16 trailers. The feeders are carried on wooden poles which are very unsightly. These feeders could have been more economically and more efficiently put under ground.

In the power house they are using a simple horizontal reciprocating engine, driving a Thomson four pole dynamo fitted with carbon brushes by means of continuous rope gearing. No sparking whatever is observed at the brushes, and nothing can work more smoothly; but the absence of condensing and the existence of rope gearing must render the engine part uneconomical.

The maximum horse-power used is 246. The voltage varies with the load from 500 to 550. The current averages 200 amperes.

The maximum number of cars on at one time is nine motors and nine trailers, and this averages at the power station 13.7 horse-power per car running. The cars run on the straight at from 16 to 20 miles an hour. The rails are 85 pounds per yard—a very heavy rail for a tramway. The usual rail is 52 pounds per yard, as at Boston; but experience in the United States of America is leading to heavy rails. The pounding and hammering on the rails with heavy loads is very great, and in Philadelphia they are using even 90 pound rails.

The trolley wire alone is not unsightly, but when it is protected with these guard wires, as at Boston, and the same poles carry the feeders, it becomes hideous, and it is astonishing that the American community submit to it. Such a system is impossible in England.

This trolley wire must be elastic, otherwise the trolley itself frequently jumps off and stops the car. Attempts have been made to improve the appearance of the road by using handsome central iron poles with solid brackets on each side to carry the two trolley wires, but the want of elasticity has introduced fresh evils. The trolley frequently comes off and great sparking is evident.

An admirable illustration of a modern electric railway is the electric *portage* between Lakes Ontario and Erie, from Chippewa to Queenstown, 13 miles long. It is on Canadian soil and built with Canadian capital, but the work was done by an American firm. It is an open overhead trolley line with iron posts and brackets. It is worked by water-power derived from the Niagara Falls.

The West End railway system of Boston is by far the most extensive electric railway system in any city in the States.

In the power station, which is situated on the harbor, there are 24 Babcock-Wilcox water tube boilers, each developing 250 horse-power.

Surface condensing is used, sea water being available for the purpose.

There are six horizontal triple expansion engines, each developing 1,000 horse power and driving by means of belting 18 Thomson-Houston four pole dynamos, all capable of being connected up in parallel, but put on and off as the load varies.

The chimney is 252 feet high and 13 feet 6 inches in diameter. It does not smoke, and the steam is generated so economically that only 11½ pounds are used for one horse-power hour.

There are three power houses in Boston, the other two developing 2,000 horse-power each, so that there are 10,000 horse-power used in Boston for working their street railway system.

The line is no longer run by contractors. It is entirely in the hands of the railway company itself. They have magnificent workshops and a very fine staff. Their chief engineer, Mr. Hirt, was extremely attentive and communicative. He supplied me with capital drawings of the works and general arrangements.

The use of belting was again surprising; but I was told that a very large railway system at Brooklyn was going to be worked by direct-driven power, so as to obtain an authoritative and convincing trial of the relative merits of the two systems. I did not learn the type of engine to be fixed at Brooklyn, and I was unable to go there to find out.

The track is light, as I have previously mentioned, but they are welding together the fish-plates and the rails so as to obtain an electrically perfect return circuit. I saw the car and apparatus used for this welding process, but I could not see it in operation, for one essential part of the plant was being repaired.

I saw the electric snow-plows used to keep the tracks clear in wintry weather.

The system of railway working in Boston has given such satisfaction to the public that the traffic returns have improved 30 per cent. owing to the changes from horses to electricity. The service is so much quicker, cleaner and better performed. A railway car in full service is said to run an average distance of 250 miles a day, and its mean speed is 15 miles an hour.

There is an important question under discussion in the United States of America—whether it is better to pursue the present practice of using two motors upon the cars, one on each wheel axle, or to use only one motor connected electrically and flexibly with the wheels by beveled gearing. This is the plan advocated and practically carried out by Mr. Sperry. The weight is thus placed in the middle. The horizontal pull is said to be greater. The starting torque is smaller. It is more easily controlled. There is no slip, and the velocity of all parts is uniform. It will climb a stiffer grade. One 35 horse-power motor replaces two 30 horse-power single reduction Thomson-Houston or Westinghouse motors with economy of energy. The system is working in Pittsburgh, where it was adopted after a very severe trial with a Westinghouse car, and it is about to be used on Twenty-second street in Chicago. It has this disadvantage—that if the motor fails there is not a second one available to take the car home. The problem is an interesting one, and its solution will be watched with great interest, for it has an important bearing on the economies of our English roads.

The feeling is pretty prevalent in the States that the conductors must eventually go underground. Experiments in this direction are being made in several directions, notably in Washington and Chicago. The trolley with its guard wires is really an abomination, and the disturbances created by insufficient return accommodation are annoying the telegraph and telephone interests, and alarming the gas and water companies. The future working must be metallic circuits and underground conduits. It is so done in Buda-Pesth, and it has been partially done in Blackpool and in Rome. Other experiments are contemplated in England. No one can doubt that the future of electric railways is very bright. The South London Railway and the Mersey Dock Elevated Railways are examples of great successes in England, but it is in the States, where this form of locomotion has become a necessity, that we are sure to see a speedy and practical solution of the problem.

CONCLUSION.

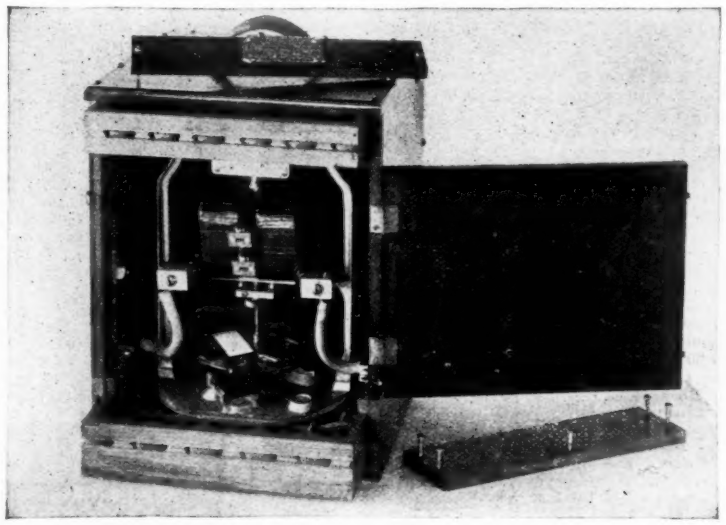
I have by no means exhausted the many notes made during my trip, but I have said enough. Interviewing is a feature of American journalism that, thank goodness, has not taken root here. I was surprised to read of interviews with myself, extending to two or three columns, that resulted from the passage of a few compliments; but I was more surprised to find that statements supposed to have been made by me to an interviewer were taken *en serieux*. One irate functionary compared an official statement of a past Postmaster General with a mythical statement made by me, and triumphantly pointed out such a glaring contradiction as a complete refutation of my fallacies. I even read that I had stated that we electricians in England had *nothing* to learn from America. I have no recollection of ever having made any remark which could by any shorthand blundering have been construed into such an absurdity; but if I had done so it would more likely have been one where "nothing" was a telegrapic error for "everything."

I cannot too gratefully speak of the attention and kindness I received from everyone, and I certainly feel that I have personally profited from my visit very much indeed.

A visit to the United States is something like charging an accumulator. It stores the visitor with energy. When I am completely discharged, and my adverse criticisms have been forgotten, I shall probably cross the Atlantic again.

Portable Thomson Recording Wattmeter for Street Car Testing.

It is frequently necessary in electric street railway practice to test the power consumption of the cars, and heretofore the General Electric Company has furnished a 500 volt-meter mounted rigidly within a mahogany box for this purpose. This was, however, found not to be without faults. The mechanism being rigidly mounted the meter was subjected to violent jars which frequently interfered with its accuracy, shortened its life and rendered it unsatisfactory. Experiments have been going on for some time past to evolve a satisfactory portable recording meter for the purpose named, and the General Electric Company now announces one which will satisfy the many requirements of street railway service.



PORTABLE THOMSON WATTMETER.

The meter in question consists of a Thomson recording meter mounted on a skeleton metal frame and having a capacity of 25 amperes at 500 volts. It is mounted within a polished wood carrying case, about two-thirds the size of the former type. Instead of being rigidly mounted in the case the meter is suspended between two networks of interlaced rubber cord, or, as it were, between two rubber hammocks. This method of suspension saves the meter from violent agitation or shocks, and renders its accuracy reliable. It is the first time that this system has been applied to the recording meter and it is a feature which will recommend it to all street railway men. The meter may be used placed upon the floor of the car with absolute safety and convenience and gives perfectly accurate readings.

This portable meter is normally rated at 25 amperes. In testing street cars, however, the current will frequently, for short intervals, very greatly exceed this, as when starting, or upon heavy grades; but this meter is said to be so constructed as to record these sudden bursts of current accurately, and enormous overloads may be carried through the meter for short intervals without detriment to the instrument or impairment of its accuracy. The meter has been subjected to careful and severe tests, which it is claimed to have stood with absolutely satisfactory results.

OUR NEW ENGLAND LETTER.

A Franchise for a 10 mile electric road has just been granted to a Holyoke company.

The Fair Haven and Westville Street Railroad has contracted for an electric plant at the cost of $500,000. The line is six miles long and the only one in the city not now electrically equipped.

Sampson & Allen, electrical engineers of Lynn, Mass., have secured a contract for the installation of an isolated electric lighting plant in the offices and warehouses of Thomas Wood & Company, of this city, and have also been awarded the contract for lighting the new Armory in Lynn.

The Property of the North Attleboro Steam and Electric Railway Company has passed into the hands of an assignee, and will shortly be sold to satisfy claims amounting to about $3,800. Henry M. Fisher, ex-Mayor of Waltham, is the assignee, and has furnished a personal bond to the amount of $15,000.

The Union Traction Company, of Providence, has purchased the mortgage of the Attleboro, North Attleboro & Wrentham Street Railroad. It is now stated that the road will be in operation by April 1. It stopped doing business last Fall after the burning of the power house in Attleboro. There has been no communication with North Attleboro since that time. Kidder, Peabody & Company, of Boston, made the sale to the traction company.

At a Town Meeting held on the evening of the 15th the citizens of Marblehead voted almost unanimously in favor of establishing an electric lighting plant in that town. It was decided to adopt a mixed system of arc and incandescent lamps for the town and arc lamps for the Neck. The estimated cost of the outfit is $50,000, $10,000 of which was appropriated at the meeting as a beginning, and the balance will be bonded. The committee on construction consists of Wm. J. Goldtwaight, Thomas W. Tucker, Henry C. Sparhawk, John B. Litchman and Benjamin G. Lindsey. Sinking fund commissioners were also elected and active operations will be at once begun.

The W. S. Hill Electric Company, of this city, are still finding business steadily on the increase, and are running more than full time in an effort to keep up with their orders. They were obliged to work all night once this week in order to make a shipment on time of a large opera house switchboard, containing all the necessary apparatus for this complicated service, for which they had an order from Scranton, Pa. They are now completing another of the same kind for a new opera house at South Manchester, Conn. Their New York representatives, the Elson & Brewster Engineering Company, have been obliged for the second time within a year to move into larger quarters. They now occupy a suite of offices at 143 Liberty street, and with better facilities and a larger stock are in good shape to take care of their steadily increasing trade.

The Improved Outlook for business and the preparations for Spring trade are being felt to a noticeable extent by the increase of tenants at "electrical headquarters" in this city. The Hathaway buildings on Atlantic avenue have long been known as the electrical center, and offer inducements to concerns in this line which are not equalled elsewhere in the city. Aside from the close association with the members of the large colony of electrical men located in these buildings, they offer inducements in the shape of small but neatly fitted up offices with a southern and southwestern exposure which are at all times cool, light and pleasant at a reasonable rental. Electric lights, elevators, mail chutes, telegraph and telephone service, a public restaurant and private lunch club, all located in the building, tend to make things pleasant, and anyone thinking of locating in Boston cannot do better than join the electrical colony. These buildings are also the headquarters of the electrical journals in New England, every one of the leading papers being represented.

Boston, March 21. H. G. T.

Electrical Measurements.

A LECTURE DELIVERED AT COOPER UNION, FEBRUARY 5, 1894.

BY A. E. KENNELLY.

(*Concluded from page 153.*)

The great value in the commercial distribution of electrical power lies largely in the fact that you are able to watch and economize by your ampere meter, or wattmeter, the amount of power that you are going to consume. With an engine it is difficult to do that. You can, of course, take diagrams from the engine. You can put indicators on the cylinders and find out the amount of power delivered to the engine at different parts of the stroke. But that is a clumsy and tedious process compared with the electrical plan. If you have a motor to drive your machinery, and it is supplied by current from mains that lead from a central distributing station, you have only to watch your ampere meter to know, with the pressure of delivery, what power you are taking from moment to moment. The great value of electrical distribution of power lies not only in the fact that you can economize so much in the superintendence of your machinery, but you are often able to see instantly when anything goes wrong with your machinery, by the effect of undue friction and extra work so absorbed upon the ammeter, which otherwise might escape unnoticed until actual damage had been done.

Now, all that we have said this evening about electric circuits is supposed to be said when the current is steadily flowing. That is to say, one volt always sends one ampere through one ohm so long as everything is steady. But if your pressure on the circuit is changed you will not get during the change the corresponding number of amperes that you would expect, and in particular when your electric pressure is alternating, when it is varying up and down from positive and negative, as it does in alternating current circuits, you do not get Ohm's law applying in the way it did in the other case. Fifty volts of alternating current will not necessarily send one ampere through a coil of wire having 50 ohms of resistance. Ohm's law only applies when your curreut is flowing steadily along. But you make a current oscillate or move in any manner and you will immediately find that a disturbance is introduced. Now we will see where that disturbance is.

Referring again to our first diagram, there is a circuit containing a pressure and a resistance and a galvanometer, and the current is steady so long as the pressure is steady, and Ohm's law applies to that circuit. But so soon as you start a current in that circuit you know it becomes magnetic just in the same way as you saw that in this wire when a current flowed through it it attracted a magnetic needle. That means that magnetism is being produced in this circuit. And the result is that magnetism is thrown into that circuit as soon as the circuit is closed. But a dynamo machine, any electro magnetic generator for producing current, is nothing more than a device for throwing magnetism into a revolving coil. The armature is situated between the poles of a large magnet and so arranged that that coil is always disposed to have more magnetism thrown into it as it comes around. The circuit here is no more than a little, weak dynamo. It generates its own magnetism. The moment you start that current that magnetism flows through that circuit, and since it flows into it in the same way that magnetism runs into the dynamo armature, it produces the same kind of pressure on a smaller scale than you meet with in a dynamo armature. It is the pressure due to the changing magnetism in the circuit which is producing a disturbance and a deviation from Ohm's law, and if you take that new pressure into account you will find that Ohm's law applies again. As soon as the current becomes steady the magnetism brought into play becomes constant and no more pressure is generated in this way.

Before passing from this portion of the subject I think you will be interested in seeing a very pretty form of very delicate galvanometer. It consists of a coil of wire something on the principle of that coil (indicating) with a very minute magnetic needle in the middle of it. It is not more than a quarter of an inch long. On the back of that needle there is a little glass mirror. The whole thing only weighs a few grains. The magnet is suspended in the center of that coil by a few fibers of silk. By turning it around you will see that in the interior space there is a little mirror. Perhaps you can just notice it. That is in the very center of the wire and, therefore, so situated as to be directly in the influence of the current that will go through that wire. Here is a lamp and the light in the lamp is supposed to pass through a slit in here, pass into the window here on to the mirror and thence reflected back to this scale again. The scale is marked off with a number of fine lines so that you can detect and measure the distance of the reflected beam from the scale zero. A little, narrow spot of light falls on the scale back from the mirror after having traversed this distance twice. Now, a very small deviation on the part of the mirror here will mean, at the distance at which that scale is placed, quite a large deviation of the reflected beam of light. The amount of delicacy which you can get from an apparatus of that kind for very feeble currents is extraordinary. You can measure the one-hundred millionth part of an ampere quite comfortably with an apparatus of this description. It is no exaggeration to say that the application of this instrument rendered submarine telegraphy possible years before it could have been accomplished by any other means. To day, it is almost the only instrument that can be employed successfully on long ocean cables. The feeble current flowing through cables has power to throw that little mirror to and fro.

One extraordinary feature about electrical measurements is the enormous range they possess. You can measure any resistance—for instance, one microhm, that is, one-millionth part of an ohm—quite comfortably, and you can measure the megohm, which is a million ohms, easily, and a million megohms without difficulty. So you can measure a range of a million times a million times a million, or a trillion ratio, which would be 1 and 18 figures after it. Now, that is a range of magnitude which scarcely occurs in any other science or art that we possess, astronomy alone excepted. Recently in astronomy there has been concluded a measurement which occupied a number of observatories and a number of men for a long period of time to ascertain whether the earth's axis shifted its position in the earth. Of course, the axis of the world, we know, is moving about on what might be termed the outline of a corrugated cone in space, producing the well known phenomena of precession and nutation. But that was not the question. Any motion of the axis in that way would move the whole world conformably, and if you went to the North Pole and drove a stick into the ice at the point which you observed to be the axis of rotation, which would not move at all, and called that the pole, that pole might point to a different part of the heavens at successive periods of time, but you would not have to shift the stick at all. Or, in other words, the earth's axis of rotation would not shift in the earth. But the suspicion was aroused that the earth's axis was not quite stationary; that the stick did shift, and it has apparently been placed beyond dispute that a steady and annual motion does take place, besides a motion which is accomplished in a period of 14 months, amounting in all to about a shifting of 30 feet. That is to say, the pole shifts in the earth about 30 feet at the surface; so that you would have to shift from time to time the stick marking the the axis of rotation over 30 feet radius in any direction. That is rather fine measurement and that represents perhaps the very limit of accuracy, which astronomical means render possible at the present time, in the very smallest mundane amount. Similarly, the very longest distance of which astronomy has been able to obtain any definite notion is a distance which light requires a hundred years to move across. Light moves about 136,300 miles in a second, and there are stars which, shining at this moment bright, are but resplendent with the lustre that left them a hundred years ago and all that time the light has been advancing onwards and onwards through space. Taking then the ratio of the 30 feet, the smallest amount, and that long distance of 100 years of light speed, it represents only about 1 with 17 zeros after it. So that you see that the electrical range of measurement of 1 with 18 figures after it is the superior.

Now, all these instruments before you have their own definite work, and one of the most important pieces of work which the Wheatstone bridge has ever done has been the determination of the spot at which an immersed submarine cable lies broken. You put a cable down across the Atlantic, and suddenly the signals disappear. Without any warning, perhaps, they are cut off altogether, and you feel that you have lost a friend — Ireland — and the question is, where is the fracture? We cannot go and pick all that cable up. If we are going to make that cable of any use at all, we must know where the fracture is, and the Wheatstone bridge is the means by which this is located, and by which a ship is enabled to go close to the spot, put a hook down, bring up the cable, and splice and repair it. To give you an idea of the means by which that is carried out, we have a circuit here strung up above our heads. All that wire represents a submarine cable. It is overhead instead of being under water, but that does not matter for the purpose in view. We are not going to cut it barbarously at any point, but we have a number of wires coming down from it at different places and they all end in a switch which is behind that pillar, and the pointing of the switch upon any one of the several plugs on it represents a break in some definite place, just as the fracture of the cable means connecting the conductor electrically with the ground at that spot, and we will show you how we will find that place by means of this Wheatstone's bridge and galvanometer. Now, if any gentleman will promise not to be in collusion with us, and will put the handle of that switch upon any plug that he is minded to, we will endeavor to determine which it is. This galvanometer is going to show us. We will apply a current to the bridge, and when we get no current through the galvanometer the resistance on the two sides will be equal, and we ought to be able to locate that spot. I am going to put on a current, and you can see that until I get the right amount of resistance the needle will move. (Some one in the audience moved the switch.) The needle is moving very considerably now. That means I have to change these plugs by a large amount until I get that back. It is coming steadily back. When I get it right on the zero point it will have told its tale. I am altering the resistance now to represent the resistance up to the point at which that switch has been turned. If the switch had been turned beyond that point I would have more resistance. I would have more lengths of wire in the circuit. I have now 128. Now I have 130. Now I have 140. It is pausing. It is coming very close. Now I have 144. I think that is over the zero point, isn't it? That corresponds to the fourth button. (A voice: That is right.)

The way we know that is this. There are altogether eight buttons and 277 ohms is the total resistance of the wire. Now half of it is 139. We have here 144, so that is just half the buttons, allowing for slight irregularities in the distance. You find out the amount of resistance there is between the end of the cable and the place where it is broken, and so many ohms represents so many miles, because the amount of resistance in a mile is very carefully measured before the cable is put down.

All the value of the labor, whether remunerative or not, that has ever been put on electrical measurements, has amply saved itself to the world by the amount of labor saved in making ocean telegraphy practicable and enabling cables to be repaired.

Now, looking at all this apparatus, it appears as so much brass and so much wood and hard rubber, having its proper functions to perform. Literally so it is. But it is much more than that. If we only think again we see that every one of these pieces of apparatus represents the crystallized energy, the crystallized thought, the life work of hundreds of those, only a few of whom are left with us. All the men who first rendered that box capable of being constructed, who first rendered the measurements it can control capable of being performed—their life work is crystallized here, and their lives are all passed from us. Isn't it wonderful to think, when we are so careful, when our lives are long problems to economize each other's labor, when the whole problem of life in its business aspect is the problem of economizing each other's labor; isn't it wonderful to think that the labor of so many hundreds, of so many thousands, really, is embodied in a simple machine of that kind? Because, while you might enumerate 20 celebrated names whose life work made that single piece of apparatus possible, you would have to enumerate hundreds or thousands of names of persons whose labors were just as necessary, collaterally, although less promiuent and important.

One thing more. The enormous value that electrical measurements have been to science, to progress, to arts, in the past, promises to be a mere iota to the value that electrical measurements will have in the future, and for this reason: We do not know why that metal plug falls to the ground when it is dropped. We know the law by which it falls, it varies inversely as the square of the distance to the earth's center of matter, etc. But we do not know why it falls. We simply say it is gravitation. And all through our knowledge of nature we are being perpetually baffled by what goes on, and the activities that are at work in a space from which we have apparently exhausted and removed all matter. If, for example, we tried to remove all the matter in this hall, we should commence by removing the pillars, which would be rather a convenience for the audience, and then all the seats, and get it empty of heavy material. Then we would say, there is the air, and we would commence to pump out the air, and if we could get a vacuum we might think that we had emptied it. Nevertheless, light would travel across the vacuum, and so would heat, and so would magnetism; and it is almost impossible to suppose those things can travel on nothing, through nothing, and we are brought face to face with the necessity of supposing that there was no vacuum at all; that far beneath the gross perception of our senses there lies a finer, a more subtle matter for which we have invented the word ether. We are not brought into contact with ether through any of our senses, except, perhaps, by light, which is supposed to be an electrical disturbance of the ether, and we have to rely on electricity and magnetism for making the pioneer efforts by which we are going to ascertain in time what this ether is and what it does. There can be no doubt that when once we know what ether is we shall be in a better position to utilize it and place it in our control, just as we place the solid bodies in solid machinery in our control, and it is from electricity and magnetism that we are to hope for a further successful investigation in this direction, but when that knowledge is finally obtained we may be fairly certain that the plenitude of the success, the vast balance of the credit, will be due to electrical measurements.

Electric vs. Horse Roads.

We have seen at various times and in various journals (electrical and otherwise) statements regarding the comparative earnings per mile of electric and horse cars on the same system, *i. e.*, the West End system of Boston. A recent statement of this kind shows that, while the mileage of the electric cars of this system was 76.17 per cent. of the entire mileage of all the cars of the system, their earnings were 80.33 per cent. of the whole, from which it is deduced that electric cars earn more money per mile run, which, it seems to us, is an entirely unjustified deduction, so far as comparisons between electric and horse cars generally are concerned.

If a street car company owning two lines, one traversing a thickly built up portion of a city where crowds of people desired to use cars, the other being in the outskirts where few people used the cars; and, if the first mentioned line used horses, while the suburban line was electrical, comparison of earnings per mile would show the horse cars to possess much the greater earning capacity. But such a comparison would be unfair to electrically driven cars.

By this criticism we do not mean at all that we prefer horse cars, but that comparisons should always be fairly made.

We think that if there were in the same street of a city two parallel lines, one with electrical and the other with horse cars, the electrical cars would show the best earnings per mile, because people would prefer them, on account of their greater speed, cleanliness, etc., and such a comparison, if it were possible to make one, would probably show greater superiority of electric over horse cars than is shown by the comparison quoted above.—*American Machinist.*

Engineering Association of the South.

The regular monthly meeting was held at Nashville, Tenn., on Thursday evening, March 8, Vice-President Smith presiding. Mr. A. P. Gaines, Cowan, Tenn.; I. O. Walker, Paris, Tenn.; and C. P. Perrin, Pikeville, Tenn., were elected to membership. Action of the board of directors, advancing Mr. Alfred Hume from junior to membership was reported. The Finance Committee, charged with the special duty of better financial arrangements, failed to report and were given further time. The treasurer reported that the association was not in debt and had some funds on hand. The paper of the evening entitled "Coal Handling Plant at Pikeville, Tenn.," by Mr. J. J. Ormsbee, superintendent Sequatchie Valley Coal and Coke Company, was read by the secretary in the absence of the author.

An Interesting Lecture.

Mr. William J. Hammer, the well-known consulting electrical engineer of New York city, delivered an interesting lecture on "Electricity" before the Dryden Literary and Musical Society at Newark, N. J., on March 7. The lecture was illustrated by quite an elaborate series of experiments in electricity and magnetism, and in the applications of electricity to lighting, power, telegraphy, telephony, war purposes, ballooning, heating and cooking. Some interesting experiments in radiant matter were also shown.

A Submarine Cable Broken.

The submarine cable between Constantinople and Odessa in the Black Sea has been broken.

Three Model Factories.

THE GREAT AND INCREASING BUSINESS OF THE WIDELY KNOWN RUBBER HOUSE OF THE NEW YORK BELTING AND PACKING COMPANY.

Our readers, we are sure, are ever interested in industrial progress, and nowhere is this better evidenced than in the every day work houses of strong manufacturing companies. The three factories of the New York Belting and Packing Company, illustrated in this issue of the REVIEW, present interesting testimony of enterprising, modern management, and we take pleasure in speaking of the details of construction and methods shown.

Factory number one, Fig. 1, is situated in Newtown, Conn., has excellent shipping facilities, and has the advantage of an exceptionally fine water power. The main building of this plant is a substantial brick structure, five stories in height, 300 feet long and 60 feet wide. Placed at right angles to this is a four story addition, 77 feet long and 30 feet wide; close to which are separate buildings for engine house, boiler house, machine shop, carpenter shop, gasometer, store houses, etc. In plain sight of the factory plant is the handsome house of the superintendent, and 30 or more neat cottages for the workmen, all of which buildings are the property of the company. Viewing this city of rubber workers built by the side of

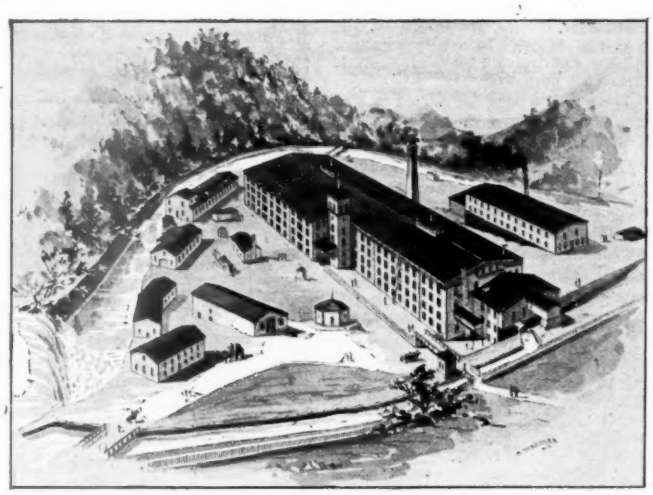


FIG. 1.—VIEW OF THE NEW YORK BELTING AND PACKING COMPANY'S FACTORY AT NEWTOWN, CONN.

a swiftly flowing river with lofty pine-clad hills rising almost to the majesty of mountains on either hand, one cannot but be struck by the beauty of the scene, as well as impressed by the prevailing air of thrift and enterprise. Entering the factory while the huge turbines are in motion one sees the washing, mixing and calendering of rubber on scores of machines, many of which are new and have labor-saving attachments that are not only up to date, but in some cases far ahead of what we had dreamed of.

Enormous hydraulic presses for belting, packing and matting are here to be seen, and at the time of our visit another 30-foot monster was being set up. Not the least interesting part of the plant is the new hose room. It is a light, airy, spacious apartment, where everything from start to finish is done by machinery. In this room a very few men are able to turn out 25,000 feet of hose a day, producing an article that is infinitely superior to hand-made hose. Mr. L. K. McClymonds, the able general manager of the company, pertinently remarked: "The belting cured under pressure is superior to the old-fashioned article that was made before we had presses, so now we make our hose under pressure and find a vast improvement in its quality." It is at this mill that the company's celebrated brands of "1846 Para" and "Double Diamond" belting, also the well-known "Test" fire hose, air brake hose and other special hose, as well as mats, matting, stair treads, etc., are manufactured.

Perhaps the most marked feature in the line of improvements that the factory exhibits is the careful avoidance of unnecessary handling of goods. It is only recently that rubber manufacturers have found this necessary, but to-day all of the progressive ones look to it most carefully. Here the problem is solved simply and satisfactorily. The raw material enters at one end of the mill and is delivered at the other in the shape of finished product. Factory number one employs about 600 workers and 600 horse of water and steam power.

The plant of factory number two, Fig. 2, while by no means small, is not as large as that just described, and indeed is used chiefly as a helpmeet for it. Here much of the raw material is prepared. It has recently been fitted with new grinders, conveyers, centrifugal machines, vulcanizers, etc., and is capable of turning out an immense amount of stock with little handling and few hands. The two brick buildings, a five story 74x50, and a two story 124x40, are situated close to the river that turns the wheels of number one, and have both water and steam to rely upon for motive power.

Factory number three, Fig. 3, the best equipped of all, is situated at Passaic, N. J. The buildings are of brick, the larger being 390x60 feet. Here is made the finer class of goods in mold work and specialties. As one steps from the office into the main building the whole process of manufacture is in sight. At the farther end, nearly 400 feet away, is the compounding room, where the rubber and ingredients added to it are weighed. Nearer are the mixers, still nearer the calenders, close at hand the presses, and then comes the tables for the finishers, and then the shipping room. Interspersed between the machines mentioned are varied mechanisms for the saving of labor, and more are being added every day; a pneumatic device for slipping jar rings off from a mandrel, and forcing another tube on at the same time; a curious cage that is full of cords of rubber in which revolves a knife, cutting them into convenient bits for mold filling; these, and a score of others, new, automatic and effective. The floors above are devoted to the making up of various goods and the storing of supplies, while the topmost story is a vast dry room where hang thousands of dollars worth of Para rubber going through with the expensive but most satisfactory process known as "air drying."

The second main building, 250x60 feet, is but just completed, and is most substantially built. A part of the lower floor is used for a shipping room, and another portion for a mixing and calendering room. The floor above is devoted to the manufacture of pneumatic tires, of which the company are large makers, and is one of the most complete and conveniently arranged departments possible. The floor above this, in turn, is a fac-simile of the splendid hose room at factory number one, and, like it, has a capacity of 25,000 feet a day. Cotton hose, rubber lined, of all sizes, is also made at this plant. A department of special interest in this factory is the emery wheel section. Here is a complete and separate plant, consisting of mixing mills, calenders, presses, molds, vulcanizers, lathes, diamond-pointed tools, and a host of special devices for use in the manufacture of vulcanite emery wheels. All kinds of wheels are made, ranging in size from a cheese box down to a lozenge, and using emery grains as coarse as rice or as fine as an almost impalpable powder. They are the original makers of the vulcanite emery wheels, and their wheels have an enviable reputation both for service and safety.

This factory is run by water-power, but is also fitted with engines for use in case of a scarcity of water. The aggregate power is put at about 1,800 horse. Electric lights are in use all over the plant, and a new system of piping is being put in place. In addition to this, a new system of shafting and gearing is being installed. In this factory, as in number one, the unnecessary handling of goods during manufacture is carefully avoided. General Manager McClymonds remarked: "The New York Belting and Packing Co., Ltd., has a wonderful name. It is known the world over, and is a synonym for first-class goods. I want to say that I value that reputation so highly that under no circumstances shall there be any cheapening of its products. Where we can see chances to improve we shall do so. New processes, new machinery, better results, we welcome, but there will be no lowering of grades, no attempted economy in the use of rubber, or the misuse of adulterants." The company has offices and store room at 15 Park Row, one of the busiest and most central parts in New York city.

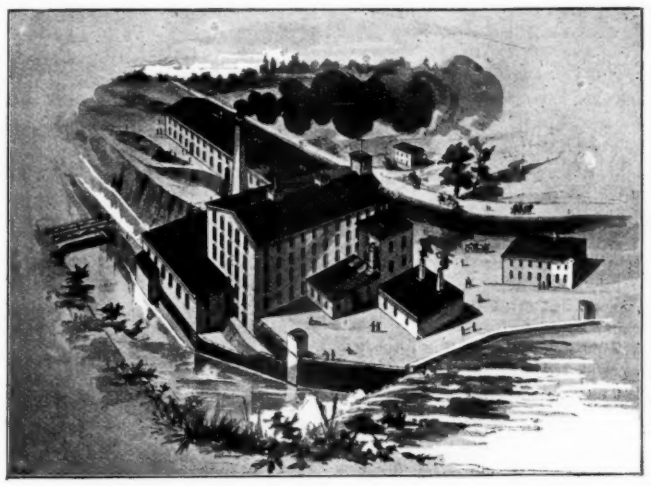


FIG. 2.—VIEW OF THE NEW YORK BELTING AND PACKING COMPANY'S FACTORY, NO. 2.

LEGAL NEWS.

The Keystone Electric Light and Power Company, of Philadelphia, has been enjoined from using any but Edison incandescent lamps.

Thomas A. Edison and Colonel Gouraud have filed an application in the Court of Chancery at Newark, N. J., for a receiver for the Edison United Phonograph Company. The bill will be answered on March 29.

In the Edison feeder and main patent case argument on appeal from Judge Green's decision upholding the patent has been concluded before the United States Circuit Court of Appeals. Decision has been reserved.

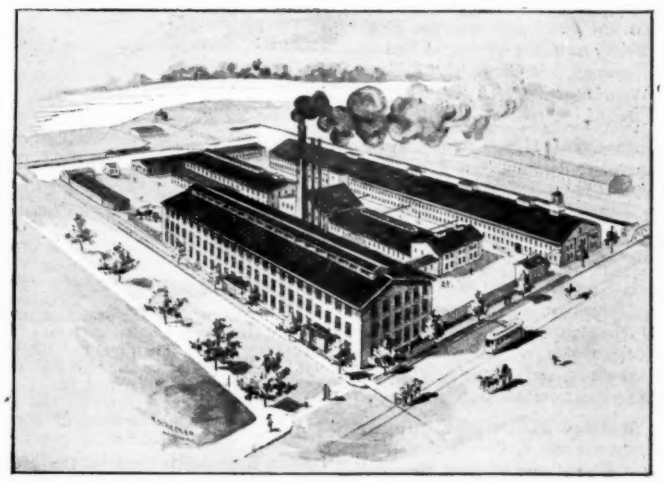


FIG. 3.—VIEW OF THE NEW YORK BELTING AND PACKING COMPANY'S FACTORY AT PASSAIC, N. J.

The Westinghouse Electric and Manufacturing Company has brought suit against the General Electric Company for infringement of the Tesla polyphase patents. The use of three-phase apparatus at the plant in Redlands, Cal., recently described in the ELECTRICAL REVIEW, is made the basis of the suit.

In the case of the Schuyler Electric Company *vs.* The Electrical Engineering and Supply Company, of Syracuse, N. Y., claiming infringement of the Perkins snap switch patent, Judge Coxe has dismissed the bill of complaint on the ground "that it would be doing an injustice to the defendant and others to give the Perkins patent a construction so broad as to suppress improvements like those embodied in the Crowell switches," which are referred to, in the court's opinion. These switches are made under patent No. 436,122, granted September 9, 1890, to Howard C. Crowell.

The argument in the Bate refrigerator case, before the full bench of the United States Circuit Court of Appeals, has been concluded. Messrs. C. E. Mitchell, J. C. Carter and P. H. Bates appeared for the appellants, and Messrs. W. H. Peckham, L. E. Curtis and Edmund Wetmore for the defendants. The argument was confined to questions of constitutional law, the special point at issue being the interpretation of Section 4,887 of the Revised Statutes, which concludes as follows:

"But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than 17 years."

The appellant contended that it should be construed to read "an invention which has been patented previous to the application for a patent therefor in the United States shall be limited," etc., while the appellees contend that the meaning is plain as it is. This case is of interest to the electrical fraternity from the fact that a decision in favor of the appellant would extend the life of the Edison lamp patent four years, and also give the American Bell Telephone Company protection on the Edison transmitter patent for 17 years from May 3, 1892. Even if the Bell company were beaten in the government suit on the Berliner patent, such a decision as the above would leave them in a strong position.

KINDRED INTERESTS

The Stirling water tube safety boiler is rapidly growing in popularity with steam users. The electrical field is adopting great numbers of the Stirling.

Alfred F. Moore, Philadelphia, is one of the oldest and most widely known houses in the insulated wire business. The product is always of the very best.

Wallace & Sons, of New York and Ansonia, Conn., are out of the hands of the receiver and are doing business in their own name at the old stand, 29 Chambers street, New York city.

The iron roof for the new car barn for the Colonial Electric Street Railway Company, of Kingston, N. Y., will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

The Eastern Electric Cable Company, Boston, under the able management of Henry A. Clark, is doing a greatly increasing business. The "Clark" wire has a splendid record.

The Helios Electric Company, of Philadelphia, has recently secured the vigorous Central Electric Company, of Chicago, as their representatives in that part of the country. A good combination.

Mr. M. W. Mix, manager of the Rice Manufacturing Company, has opened commodious warerooms at 43 Dey street, New York city, and will there carry a complete line of power transmission machinery.

The Armington & Sims engines are as popular as ever. This is a successful and thoroughly practical engine manufacturing company. E. P. Hampson & Company, 36 Cortlandt street, are the New York agents.

The Okonite Company's new insulated clock has made a hit. If it keeps time as well as the Okonite insulation withstands the inroads of time and the elements. It will be a valuable addition to the busy man's desk everywhere.

The "Jupiter" Storage Battery, manufactured by the Day-Moberg Electric Company, of Boston, is meeting with a large sale. Portable cells are a specialty with this company. Its trade-mark is a striking one.

The Goubert Manufacturing Company.—Every station man should possess a copy of "Dry Steam, the Foundation of Economy." If you haven't it send to the Goubert Company, New York, and get a copy, free.

The Ansonia Brass and Copper Company, Cliff street, New York, is one of the oldest and most reliable houses in the business. They deal in a l kinds of bare and insulated wire and make a specialty of railway feeder and trolley wires.

The Riker Electric Motor Company, of Brooklyn, N. Y., is widely experienced in the manufacture of electric motors for yachts, launches, etc. This is the beginning of the season and the yacht owners will get good service from the Riker company.

The Malden Machine Company, 27 Westminster street, Providence, R. I., has issued a catalogue of more than ordinary interest to power users. It describes the various applications of the Porter water wheel to power transmission and contains many useful and valuable tables.

The Berlin Iron Bridge Company is the most ably managed company of its kind in business. The broad-gauged methods of President Chas. M. Jarvis and his active, alert associates have told effectively during the hard times, and the company is crowded with the best kind of business.

The General Incandescent Arc Light Company, New York, are meeting with great success in the sale of their blade switches, which are made up to 1,750 amperes and in special sizes. These switches have a carrying capacity of 55 amperes per square inch of contact surface, and those who have used them are high in their praise.

The Manhattan Electrical Supply Company has removed its sales department from 86 Cortlandt street to more commodious quarters on the ground floor of 32 Cortlandt street, New York city. Their pamphlet describing a number of styles of electric telephones which they manufacture is now ready for distribution.

The Charles Plumb Electrical Works are located at 89 Erie street, Buffalo, N. Y., and Mr. Plumb is giving his personal attention to all orders. In addition to the regular line of electrical apparatus, Mr. Plumb is prepared to manufacture and repair static apparatus, frictional machines, physicians' electro-medical apparatus and electro-mechanical devices.

The Metropolitan Electric Company, Chicago, under the broad-gauged management of President Wm. H. McKinlock and his alert staff, is rapidly winning favor in all directions. No man in the electrical business better understands the field than the active and far seeing head of this house. Mr. McKinlock's thorough business-like methods have brought him deserved success.

John A. Roebling's Sons Company, Trenton, N. J., have an attractive reproduction of their World's Fair exhibit which they are sending out. A view of the traction cable used on the Third avenue cable railway, New York city, surrounded by coils of insulated wires and cables, occupies the front part of the engraving with a large picture of the Brooklyn Bridge in the background.

F. E. Reed & Company, 120 to 124 Gold street, Worcester, Mass., manufacturers of machine tools, have issued one of the best machinery catalogues that we have seen. They have followed the commendable recommendation of the American Society of Mechanical Engineers that all such catalogues be made of the standard size, 6x9 inches, for convenience in binding. The present catalogue contains illustrations and descriptions of lathes and other machine tools made by F. E. Reed & Company from new and improved patterns.

The General Electric Company reports having just closed a large contract with the Cataract Construction Company for the furnishing of about 2,000 horse-power of apparatus to be used in the plant of the Pittsburgh Reduction Company at Niagara Falls, the apparatus in question transforming the two phase current delivered from the station of the Cataract company at 2,500 volts into continuous current at 160 volts for the use of the Reduction company. The plant of the Pittsburgh company is located about 2,500 feet from the Cataract company. There will be furnished eight 200 kilowatt step-down transformers and four 370 kilowatt revolving transformers for transforming two-phase current into continuous current. It is believed that this will be the largest plant of the kind in the world, and the installation will mark an interesting step in the development of the use of multiphase currents for transmission purposes, being again transformed into direct currents at the point of utilization. In addition to the apparatus above mentioned the General Electric Company also furnishes the necessary switchboard and appliances.

Boston Representatives of the Mather Electric Company.

The secretary of the Mather Electric Company, of Manchester, Conn., writes us to state that Messrs. Angier & Company are this company's duly authorized representatives in Boston and vicinity. They have no one else in Boston and wish to correct the announcement recently made that they had other representatives in that city. Mr. Angier is well-known to the electrical field, having been for a long time actively connected with Messrs. Claflin & Kimball at 116 Bedford street, Boston.

LITERARY.

"Consular Reports" for March, 1894, has been received.

A "Directory of Indian Manufactories for 1894" has been received from the proprietors of the *Indian Textile Journal*, Bombay, India.

H. C. Bunner, who has long made a study of phases of New York life, writes in the April *Scribner* of "The Bowery and Bohemia," describing the shifting scene of the real Bohemia from the days of Pfaff's saloon to the present.

We have received from Mr. W. D. Sargent, vice-president and general manager of the New York and New Jersey Telephone Company, a copy of the "Report of the Board of Commissioners of Electrical Subways of the City of Brooklyn, N. Y.," an abstract of which appeared in the ELECTRICAL REVIEW for March 21, 1894.

"Transactions of the American Institute of Electrical Engineers, Vol. X," from January, 1893, to December, 1893, has been received. The volume contains an excellent autograph portrait of Past President Alexander Graham Bell, and consists of 719 pages, including a catalogue of members. The work reflects great credit on Secretary Ralph W. Pope.

"The Practical Management of Dynamos and Motors," by Prof. F. B. Crocker and Dr. S. S. Wheeler. Second edition, revised and enlarged. 205 pages, 99 illustrations. Price, $1. Sent post free on receipt of price by the ELECTRICAL REVIEW Publishing Company, 13 Park Row, New York.

That there was a need for a work of this character is shown by the fact that the first edition of the book was exhausted in less than a year. The authors have taken advantage of the opportunity for revision and enlargement presented by the issue of the second edition, and have made a few corrections and many additions. Part IV has been added, giving special instructions for handling the Thomson-Houston, Brush and other arc light dynamos. The statements made in the book are directly based on actual experience.

"The Universal Electrical Directory" (J. A. Berly's), 1894. H. Alabaster, Gatehouse & Company, London. Bound in scarlet cloth, gilt lettered, Royal, 8vo., 888 pp. Price, four shillings.

This is the thirteenth annual edition of this valuable work. The book for 1894 comprises the names of the members of the electrical and kindred fraternities throughout the world. The amount of work entailed in its compilation may be judged from the fact that the British sections contain about 16,386 names, the Continental sections contain about 13,880 names, the American sections contain about 9,370 names, the Colonial sections contain about 2,155 names, a total of 41,791 entries, many of which appear more than once. There are, however, approximately 18,414 names of different individuals and firms contained in the book.

For simplicity and facility of reference it is divided into four groups: British, Continental, American and Colonial, which are again sub-divided into alphabetical and classified sections.

The new names incorporated in the present issue number several thousands, and the total of pages added to the work is 104 as compared with that of 1893, making in all about 800 pages entirely of directory matter. It is, therefore, the largest, as it is the oldest, electrical directory in the world. The price remains as before, namely, four shillings.

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